

EXHIBIT G

**UNITED STATES INTERNATIONAL TRADE COMMISSION
WASHINGTON, D.C.**

In the Matter of

**CERTAIN 3G MOBILE HANDSETS
AND COMPONENTS THEREOF**

Investigation No. 337-TA-_____

**COMPLAINT OF INTERDIGITAL COMMUNICATIONS, LLC AND
INTERDIGITAL TECHNOLOGY CORPORATION
UNDER SECTION 337 OF THE TARIFF ACT OF 1930, AS AMENDED**

COMPLAINANTS

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C	Prosecution History of United States Patent No. 7,190,966 ¹
D	Copies of Additional ² References Cited in the Prosecution History of U.S. Patent No. 7,190,966
E	CONFIDENTIAL Copies of Complainant InterDigital's License Agreements
F	Physical Sample of Nokia N75 Handset

¹ Appendix C contains Patent Office records related to the last application in the line of applications leading to issuance of the '966 patent. Since the '966 patent is a continuation of the '004 patent, the Patent Office records related to the earlier applications in the line are contained in Appendix A, which is the prosecution history for the '004 patent.

² Because the '966 patent is a continuation of the '004 patent, Appendix D only contains copies of each reference that is cited on the face of the '966 patent or mentioned in its prosecution history, but not in the prosecution history of the '004 patent. The references cited in the prosecution history of the '004 patent are included in Appendix B.

I. INTRODUCTION

1. This Complaint is filed by InterDigital Communications, LLC and InterDigital Technology Corporation (collectively referred to as "InterDigital") under Section 337 of the Tariff Act of 1930, as amended, 19 U.S.C. § 1337, based on the unlawful importation into the United States, the sale for importation, and the sale within the United States after importation by owners, importers, or consignees of certain 3G mobile handsets and components thereof that infringe any of United States Letters Patent Nos. 7,117,004 ("the '004 patent") and 7,190,966 ("the '966 patent") (sometimes collectively referred to as "the asserted patents").

2. The proposed respondents are: Nokia Corporation and Nokia Inc. (sometimes collectively referred to as "Nokia").

3. Certified copies of the '004 and '966 patents are attached to this Complaint as Exhibits 1 and 2. InterDigital owns all right, title, and interest in each of the asserted patents. The '004 and the '966 patent share the same recorded assignment, a certified copy of which is attached to this Complaint as Exhibit 3.

4. An industry as required by 19 U.S.C. § 1337(a)(2) and (3) exists in the United States relating to the technology protected by the asserted patents.

5. InterDigital seeks, as relief, an exclusion order barring from entry into the United States infringing 3G mobile handsets and components thereof imported by or on behalf of the respondents. InterDigital also seeks, as relief, cease-and-desist orders prohibiting the sale for importation, importation, sale after importation, offer for sale, advertising, testing, the solicitation of sales, and other commercial activity relating to infringing 3G mobile handsets and components thereof.

II. COMPLAINANT

6. Complainant InterDigital Communications, LLC is a Pennsylvania limited liability company with its principal place of business at 781 Third Avenue, King of Prussia, Pennsylvania 19406-1409.³ InterDigital Technology Corporation is a Delaware corporation with its principal place of business at Hagley Building, Suite 105, 3411 Silverside Road, Concord Plaza, Wilmington, Delaware 19810-4812. InterDigital Communications, LLC and InterDigital Technology Corporation are subsidiaries of InterDigital, Inc., a Pennsylvania corporation.

7. Since 1993, InterDigital has been engaged in the research, development, engineering, and licensing of Code Division Multiple Access ("CDMA") technology in the United States. That work later transitioned into research, development, engineering, and licensing of Wideband CDMA technology ("WCDMA"). WCDMA is one of the wireless technologies often referred to commercially as "3G."

8. At its King of Prussia, Pennsylvania, and Melville, New York facilities, among other activities, InterDigital researches, develops, engineers, and licenses technology for 3G mobile handsets. InterDigital also files and prosecutes worldwide patent applications covering its innovative research and development of 3G mobile technology and communications protocols used in connection with that technology.

9. InterDigital's research, development, and engineering business has developed proprietary technology that is used in most, if not all, 3G WCDMA handsets made throughout

³ InterDigital Communications, LLC was previously known as InterDigital Communications Corporation, but in connection with an internal corporate reorganization, effective July 3, 2007, InterDigital Communications Corporation (a Pennsylvania corporation) became InterDigital Communications, LLC (a Pennsylvania limited liability corporation). When referring to historical events, the term "InterDigital" will include the activities of InterDigital Communications Corporation.

the world. InterDigital's technology has been licensed to significant handset manufacturers throughout the world, including, at times in the past, Nokia.

III. PROPOSED RESPONDENTS

10. Respondent, Nokia Corporation, is a Finnish corporation, with its principal place of business at Keilalahdentie 2-4, P.O. Box 226, FIN-00045 Nokia Group, Finland. Upon information and belief, Nokia Corporation is involved in the design, development and manufacture of 3G mobile handsets through its Mobile Phones Business Group.

11. Respondent, Nokia Inc., is a Delaware corporation, with its principal place of business at 6000 Connection Drive, Irving, Texas 75039. Upon information and belief, Nokia Inc. (d/b/a Nokia Mobile Phones) distributes Nokia-branded handsets in the United States.

IV. THE TECHNOLOGY AND PRODUCTS-AT-ISSUE

12. The technology and products-at-issue concern mobile handsets for use in Third Generation or "3G" systems.

13. The first generation of cellular systems deployed in the United States in the late 1990s was referred to as Advanced Mobile Phone Service, or "AMPS." A variety of entities proposed improvements in that system, leading to "Second Generation" or "2G" systems. Those 2G systems used either Time Division Multiple Access ("TDMA") or Code Division Multiple Access ("CDMA") technology. The drawbacks of these systems spurred further improvements, resulting in so-called "3G" systems that were first deployed in Asia and later in Europe and the United States.

14. The components common to all 3G cellular systems include mobile devices and base stations. A mobile device can be either a portable cellular handset or a cellular PC card used in laptops. Base stations, which include towers, act as the first point of access for the

mobile device into the cellular system. To place a call, for example, a mobile device must first establish communication with a base station over a communication channel.

15. In a 3G cellular CDMA system, many mobile devices share the same frequency channel in the system. This sharing of the frequency channel, while enhancing the efficiency of the system, leads to a gradual degradation of the system performance as the number of mobile devices in the system increases because signals transmitted by each mobile device in the system contribute to the overall interference in the system. It is, therefore, important to minimize the power level at which each mobile device transmits, thereby minimizing the overall interference in the system while at the same time providing an acceptable communication quality to users of mobile devices. Controlling the power transmitted from a mobile device is important, for example, when the device first attempts to establish communication with a base station, such as when a user attempts to place a call using the mobile device.

16. In addition to minimizing the power transmitted by a mobile device as it tries to gain access to a cellular system, it is also important for the device to gain access as quickly as possible. Reducing the access time improves the performance of the system as perceived by users when, for example, they attempt to place calls.

17. InterDigital's continuing development efforts to improve CDMA cellular systems through development of WCDMA technologies have significantly contributed to the evolution of the 3G systems.

18. The specific products-at-issue in this Investigation are mobile handsets, as well as components thereof, that are capable of operating in 3G cellular systems. The mobile handsets at issue operate as cellular mobile telephones, allowing users of the handsets to place and receive

telephone calls as well as to run data applications, such as web browsing and audio and video streaming.

V. THE ASSERTED PATENTS AND NON-TECHNICAL DESCRIPTION OF THE INVENTIONS

19. There are two asserted patents in this Investigation: U.S. Patent No. 7,117,004 (“the ’004 patent”) and U.S. Patent No. 7,190,966 (“the ’966 patent”).

A. U.S. Patent No. 7,117,004

1. Identification of the Patent and Ownership by InterDigital

20. The ’004 patent, titled “Method and Subscriber Unit for Performing an Access Procedure,” issued on October 3, 2006, to inventors Gary Lomp and Fatih Ozluturk. The ’004 patent is based on Patent Application Serial No. 10/866,851 filed on June 14, 2004, and claims priority to an application filed on June 27, 1996.

21. The ’004 patent has 18 independent claims and 48 dependent claims. Claims 1, 2, 7-10, 14, 15, 21, 22, 24, 30-32, 34, 35, 46, 47, 49, 59, and 60 are being asserted in this Investigation.

22. InterDigital Technology Corporation owns by assignment the entire right, title, and interest in and to the ’004 patent. *See* Exhibit 3.

23. This Complaint is accompanied by a certified copy and three copies of the prosecution history of the ’004 patent and four copies of each reference cited on the face of the ’004 patent or mentioned in its prosecution history. *See* Appendices A and B.

2. Non-Technical Description of the Patent

24. The ’004 patent generally covers improvements to the way a mobile device gains access to a cellular CDMA system. In a CDMA system, the signals transmitted by mobile devices contribute to the overall interference in the system. To minimize interference, it is

particularly important that mobile devices transmit at the minimum possible power level necessary to gain access to the system. It is also important for mobile devices to gain access to the system as quickly as possible when, for example, users attempt to place calls.

25. The improvements of the '004 patent achieve the above and other objectives. When a mobile device attempts to gain access to a cellular CDMA system, the mobile device starts transmitting short probe signals at an initial low power and gradually increases its transmission power until a base station in the system detects one of the short probe signals transmitted by the mobile device. In this fashion, the mobile device "ramps up" its transmission power until the base station hears the mobile device. Transmitting short probe signals while ramping up the power of the signals during the initial attempt to access the system enables the mobile device to gain access to the system in an efficient and rapid manner with minimal contribution to interference in the system.

26. In contrast to the power ramp up improvements of the '004 patent, prior known approaches employed a series of long signals, which included a message intended to be communicated along with a header. By repeatedly transmitting the entire long message and header, the initial power ramp up procedure introduced substantial unwanted interference into the system, and it took longer for mobile devices to gain access to the system. The additional interference caused poor system performance, including poor connections and failed call attempts. The prior approaches also resulted in longer delays for mobile devices to gain access to the system, further degrading system performance.

3. Foreign Counterparts to the Patent

27. The '004 patent and its related U.S. applications have a number of foreign counterparts. Those foreign patents and applications, as well as related U.S. applications and patents, are identified in Exhibit 4.

4. Licenses

28. Under Commission Rule 210.12(a)(9)(iii), a list of licensed entities is attached to this Complaint as Confidential Exhibit 5. Under Commission Rule 210.12(c)(1), three copies of the licenses are submitted with this Complaint as Confidential Appendix E.

B. U.S. Patent No. 7,190,966

1. Identification of the Patent and Ownership by InterDigital

29. The '966 patent, titled "Method and Apparatus for Performing an Access Procedure," issued on March 13, 2007, to inventors Gary Lomp and Fatih Ozluturk. The '966 patent is based on Patent Application Serial No. 11/169,490 filed on June 29, 2005, and claims priority to the same June 27, 1996 application, to which the asserted '004 patent also claims priority. The '996 patent resulted from a continuation of the application that led to the asserted '004 patent.

30. The '966 patent has 1 independent claim and 11 dependent claims. Claims 1, 3, and 6-12 are being asserted in this Investigation.

31. InterDigital Technology Corporation owns by assignment the entire right, title, and interest in and to the '966 patent. *See* Exhibit 3.

32. This Complaint is accompanied by a certified copy and three copies of the portion of the prosecution history of the '966 patent that is not included in Appendix A (the prosecution of the '004 patent) and four copies of each reference that was cited on the face of the '966 patent or mentioned in its prosecution history but not already included in Appendix B. *See* Appendices C and D.

2. Non-Technical Description of the Patent

33. The '966 patent generally covers improvements to the way a mobile device gains access to a cellular CDMA system. In a CDMA system, the signals transmitted by mobile

devices contribute to the overall interference in the system. To minimize interference, it is particularly important that mobile devices transmit at the minimum possible power level necessary to gain access to the system. It is also important for mobile devices to gain access to the system as quickly as possible when, for example, users attempt to place calls.

34. The improvements of the '966 patent achieve the above and other objectives. When a mobile device attempts to gain access to a cellular CDMA system, the mobile device starts transmitting short signals at an initial low power and gradually increases its transmission power until a base station in the system detects one of the short signals transmitted by the mobile device. After the base station hears the mobile device, the mobile device then transmits to the base station a message that is longer in duration than each of the successively transmitted short signals, indicating to the base station that the mobile device wants to establish communication with the base station. In this fashion, the mobile device "ramps up" its transmission power until the base station hears the mobile device. Transmitting short signals while ramping up the power of the signals during the initial attempt to access the system enables the mobile device to gain access to the system in an efficient and rapid manner with minimal contribution to interference in the system.

35. In contrast to the power ramp up improvements of the '966 patent, prior known approaches employed a series of long signals, which included a message intended to be communicated along with a header. By repeatedly transmitting the entire long message and header, the initial power ramp up procedure introduced substantial unwanted interference into the system, and it took longer for mobile devices to gain access to the system. The additional interference caused poor system performance, including poor connections and failed call

attempts. The prior approaches also resulted in longer delays for mobile devices to gain access to the system, further degrading system performance.

3. Foreign Counterparts to the Patent

36. The '966 patent and its related U.S. applications have a number of foreign counterparts. Those foreign patents and applications, as well as related U.S. applications and patents, are the same as those identified in connection with the related '004 patent, and are identified in Exhibit 4.

4. Licenses

37. Pursuant to Commission Rule 210.12(a)(9)(iii), a list of licensed entities is attached to this Complaint as Confidential Exhibit 5. Pursuant to Commission Rule 210.12(c)(1), three copies of the licenses are submitted with this Complaint as Confidential Appendix E.

VI. UNLAWFUL AND UNFAIR ACTS OF RESPONDENTS— PATENT INFRINGEMENT

38. The accused products are cellular telephone handsets capable of operating within a 3G system.

39. Generally, any of respondents' handsets capable of operating in a 3G WCDMA system are accused of infringing claims 1, 2, 7-10, 14, 15, 21, 22, 24, 30-32, 34, 35, 46, 47, 49, 59, and 60 of the '004 patent, and claims 1, 3, and 6-12 of the '966 patent.

40. In order to confirm that the accused products operate in the manner covered by the asserted patents, InterDigital has tested a selected accused product using analytical techniques that are generally accepted in the industry. The results of those analyses support the infringement allegations set forth in the claim charts accompanying this Complaint.

41. On information and belief, the respondents collectively manufacture, import, and sell in the United States after importation 3G mobile handsets that infringe one or more of the asserted patents. On information and belief, certain Nokia handsets can operate in a 3G WCDMA system. For example, at least the Nokia N75 handset infringes one or more of the asserted patents. The identification of a specific model is not intended to limit the scope of the investigation, and any remedy should extend to all infringing models.

42. A chart that applies representative claim 1 of the '004 patent to the accused Nokia N75 handset is attached to this Complaint as Exhibit 6.

43. A chart that applies representative claim 1 of the '966 patent to the accused Nokia N75 handset is attached to this Complaint as Exhibit 7.

44. To the extent any of the asserted claims require products sold by the respondents to be operated in a 3G WCDMA system in order to satisfy all claim elements, on information and belief, the accused products infringe both directly and indirectly.

45. On information and belief, the respondents test or operate the accused products in the United States by using them in a 3G WCDMA system and performing the claimed methods, thereby directly infringing any claim requiring such operation.

46. Respondents have had notice of the asserted patents since before the filing of this Complaint or, at a minimum, will receive notice of the asserted patents upon the filing of this Complaint.

47. The accused product listed above is specifically designed to be used in a 3G WCDMA system. When the accused products are operated in a WCDMA system, they have no substantial non-infringing use.

48. Respondents induce infringement of the asserted claims by advertising their products as complying with the 3G WCDMA standards and being capable of operating according to those standards, by publishing manuals and promotional literature describing the operation of the accused devices in an infringing manner according to the 3G WCDMA standards, and by offering support and technical assistance to their customers that encourage use of the accused products in ways that infringe the asserted claims.

VII. SPECIFIC INSTANCES OF UNFAIR IMPORTATION AND SALE

49. On or around May 4, 2007, representatives for InterDigital purchased several imported Nokia handsets in the United States. Exhibit 13 is a copy of a receipt for the purchase of a Nokia N75 handset, and a series of photographs of the handset and the box in which the handset was delivered. The label on the box bears a Nokia logo. The label on the inside of the handset states that the handset was made in Finland. A physical sample of the Nokia N75 handset (that was purchased as described above) is submitted with this Complaint as Appendix F.

VIII. HARMONIZED TARIFF SCHEDULE ITEM NUMBERS

50. On information and belief, the Harmonized Tariff Schedule of the United States item numbers under which the infringing Nokia handsets or components thereof may be imported into the United States may be at least HTSUS 8525 and subsections thereof (including 8525.20.05, 8525.20.30, and 8525.20.90), 8527.90.40, 8527.90.95, and 8529 and subsections thereof.

IX. RELATED LITIGATION

51. There has been no court or agency litigation, domestic or foreign, involving the specific unfair acts asserted in this Complaint.

52. Nokia filed a suit in 2005 against InterDigital Communications Corporation and InterDigital Technology Corporation in the U.S. District Court for the District of Delaware seeking a declaratory judgment that a number of InterDigital patents relating to cellular telephone technology were invalid or not infringed. Neither of the asserted patents was the subject of any declaratory judgment request, and that declaratory judgment claim was dismissed by the Court. The complaint also claimed that certain of InterDigital's statements that certain of InterDigital's patents are essential to the 3G standard violated the Lanham Act. *See Nokia Corp. v. InterDigital Communications Corp.*, Civ. Action No. 05-16 (D. Del. 2005). Nokia later identified specific InterDigital patents and alleges such patents are not essential to the 3G standard. Although neither of the asserted patents was specifically identified by Nokia as allegedly not essential to the 3G standard, pursuant to a First Amended Case Management Order issued on July 9, 2007, by the Special Master in the case, Nokia may later identify additional InterDigital patents to be included in the case. Moreover, also pursuant to the First Amended Case Management Order, Nokia's attempt to take discovery on validity, infringement, and enforceability was denied, but Nokia may seek to modify this limitation after claim construction.

53. In 2003, a dispute arose between InterDigital and Nokia concerning Nokia's royalty obligations under a Patent License Agreement. This matter was submitted to arbitration, and in mid-2005 the Arbitral Tribunal issued its award finding, among other things, that Nokia's obligation to pay certain royalties had been triggered. There was a subsequent action in the Southern District of New York confirming the Award and also a subsequent arbitration between the parties. In April 2006, the parties settled these disputes in a manner that provided Nokia with a 2G license for certain products and a release for certain 3G-related activities occurring before

the effective date of the settlement. There is no ongoing 3G license between InterDigital and Nokia.

54. On March 23, 2007, InterDigital filed a complaint with the International Trade Commission identifying as proposed respondents Samsung Electronics Co., Ltd., Samsung Electronics America, Inc., and Samsung Telecommunications America LLC, and alleging infringement of the '004 patent, U.S. Patent No. 6,674,791 ("the '791 patent"), and U.S. Patent No. 6,973,579 ("the '579 patent"). The complaint requested that the Commission institute an investigation and, after determining there had been a violation of 19 U.S.C. § 1337, issue a permanent exclusion order and a permanent cease-and-desist order. An investigation was instituted on April 20, 2007, as Investigation No. 337-TA-601. On June 4, 2007, InterDigital filed an amended complaint in that investigation alleging infringement of the '966 patent. That investigation is currently in discovery.

55. On March 23, 2007, the same day InterDigital filed the complaint in Investigation No. 337-TA-601, InterDigital filed a complaint against the same Samsung entities in the U.S. District Court for the District of Delaware alleging infringement of the '004, '791, and '579 patents. *See InterDigital Communications Corp. v. Samsung Electronics Corp., Ltd.*, Civ. Action No. 07-165 (D. Del. 2007). On May 4, 2007, InterDigital filed an amended complaint in that action alleging infringement of the '966 patent. This action in the District of Delaware has been stayed until the ITC determination in Investigation No. 337-TA-601 becomes final.

56. On March 23, 2007, the same day InterDigital filed the complaints in Investigation No. 337-TA-601 and in the U.S. District Court for the District of Delaware, Samsung Telecommunications America LLP ("Samsung Telecom") and Samsung Electronics Co., Ltd. ("Samsung Electronics") filed a complaint against defendants InterDigital Communications

Corporation, InterDigital Technology Corporation, and Tantivy Communications, Inc. in the U.S. District Court for the District of Delaware. The complaint seeks damages and injunctive relief for defendants' alleged refusal to comply with their contractual obligations to be prepared to license their patents on fair, reasonable, and nondiscriminatory ("FRAND") terms. The complaint also seeks declarations that (i) InterDigital's alleged refusal to provide FRAND licenses to Samsung Telecom or Samsung Electronics constitutes an unfair business practice; (ii) Samsung Telecom and Samsung Electronics have a right to InterDigital's patents by virtue of their relationship with Qualcomm Incorporated; (iii) the claims of various InterDigital's patents are unenforceable; (iv) the claims of various InterDigital's patents are invalid; and (v) the claims of various InterDigital's patents are not infringed by Samsung Telecom or Samsung Electronics. *See Samsung Electronics Corp., Ltd. v. InterDigital Communications Corp.*, Civ. Action No. 07-167 (D. Del. 2007). Neither of the asserted patents was specifically identified in the complaint. This action has been stayed until September 14, 2007.

X. THE DOMESTIC INDUSTRY

57. InterDigital has established a domestic industry under at least 19 U.S.C. § 1337(a)(3)(C).

58. A domestic industry exists with respect to InterDigital's activities in the United States that exploit the asserted patents by reason of InterDigital's substantial investment in domestic research, development, engineering, and licensing of the WCDMA technology protected by the patents, including past and present development of the technology itself, testing of that technology and components, and technical support services to licensees. InterDigital's research activities with respect to CDMA technology date back to 1993 and continue today.

A. Investments in Research and Development, and Engineering

59. InterDigital operates facilities in King of Prussia, Pennsylvania and Melville, New York that are used for the research and development and engineering of technology used in the 3G mobile handsets at issue and covered by the asserted patents.

60. In 1993, InterDigital began working on research and development of a CDMA technology at its Melville, New York facility. That work later transitioned into research and development of WCDMA technology. That WCDMA technology is utilized by handsets and PC cards today, including in the accused products, and is covered by the '004 and '966 patents. In 1997, InterDigital also began working on CDMA research and development projects at its King of Prussia location. Between 1993 and 1999, InterDigital employed between 21 and 130 engineering and technical staff, associated support personnel, and management personnel in that research.

61. The value of InterDigital's plant and equipment and the specific number of employees involved in these research and development activities are disclosed in more detail in Confidential Exhibit 14.

B. Investments in Licensing

62. InterDigital has invested in personnel and resources to monitor the market, identify potential manufacturers and users of its 3G wireless technology, establish contacts with those potential manufacturers and users, provide pre-licensing technical services, negotiate licenses, conduct technology transfers, and monitor licensee compliance with the licensing program.

63. InterDigital's 3G wireless technology licensing efforts include the '004 and '966 patents.

64. InterDigital's investments in intellectual property and technology licensing operations attributable to domestic industry activities exploiting the '004 and '966 patents are set forth in more detail in Confidential Exhibit 14.

XI. RELIEF REQUESTED

65. WHEREFORE, by reason of the foregoing, Complainant InterDigital respectfully requests that the United States International Trade Commission:

(a) Institute an immediate Investigation pursuant to Section 337 of the Tariff Act of 1930, as amended, 19 U.S.C. § 1337(a)(1)(B)(i) and (b)(1) with respect to violations of Section 337 based upon the importation, sale for importation, and sale after importation into the United States of infringing 3G mobile handsets and components thereof that infringe one or more of the asserted claims of InterDigital's United States Letters Patent Nos. 7,117,004 or 7,190,966;

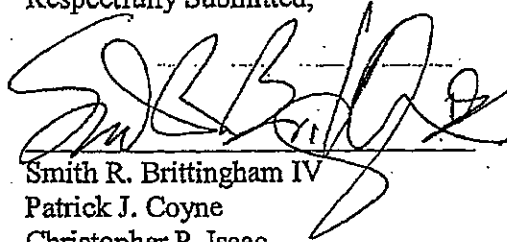
(b) Schedule and conduct a hearing on said unlawful acts and, following said hearing;

(c) Issue a permanent exclusion order pursuant to 19 U.S.C. § 1337(d)(1) barring from entry into the United States all infringing 3G mobile handsets and components thereof imported by or on behalf of any of the respondents;

(d) Issue a permanent cease-and-desist order, pursuant to 19 U.S.C. § 1337(f), directing each respondent to cease and desist from importing, marketing, advertising, demonstrating, warehousing inventory for distribution, offering for sale, selling, distributing, licensing, or using 3G mobile handsets or components thereof that infringe one or more claims of the asserted patents; and

(e) Grant such other and further relief as the Commission deems just and proper based on the facts determined by the Investigation and the authority of the Commission.

Respectfully Submitted,



Smith R. Brittingham IV
Patrick J. Coyne
Christopher P. Isaac
Lionel M. Lavenue
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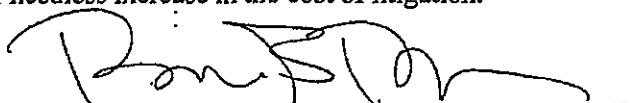
Counsel for Complainants
InterDigital Communications, LLC and
InterDigital Technology Corporation

VERIFICATION OF COMPLAINT

I, Bruce G. Bernstein, declare, in accordance with 19 C.F.R. §§ 210.4 and 210.12(a), under penalty of perjury, that the following statements are true:

1. I am the Chief Intellectual Property and Licensing Officer for Complainant InterDigital Communications, LLC as well as for Complainant InterDigital Technology Corporation. I am duly authorized to sign this Complaint on behalf of both Complainants.
2. I have read the foregoing Complaint.
3. To the best of my knowledge, information, and belief, based on reasonable inquiry, the foregoing Complaint is well-founded in fact and is warranted by existing law or by a non-frivolous argument for the extension, modification, or reversal of existing law or the establishment of new law.
4. The allegations and other factual contentions have evidentiary support or are likely to have evidentiary support after a reasonable opportunity for further investigation or discovery.
5. The foregoing Complaint is not being filed for an improper purpose, such as to harass or to cause unnecessary delay or needless increase in the cost of litigation.

Executed on: August 6, 2007


Bruce G. Bernstein
Chief Intellectual Property and Licensing Officer
InterDigital Communications, LLC

Executed on: August 6, 2007

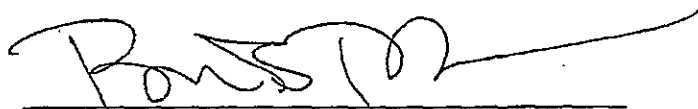

Bruce G. Bernstein
General Patent Counsel
InterDigital Technology Corporation

EXHIBIT 6
INFRINGEMENT OF U.S. PATENT NO. 7,117,004 - Nokia N75

CLAIM 1	INTERDIGITAL'S INFRINGEMENT PROOFS
	<p>Report of Investigation of Nokia N75 (Exhibit 8) Web Page From Nokia's Website (Exhibit 9) 3GPP TS 25.211, Version 3.12.0, Release 1999 (Exhibit 10) 3GPP TS 25.213, Version 3.9.0, Release 1999 (Exhibit 11)</p>
<p>1. A method for performing power control in a wireless code division multiple access communication system, the method comprising:</p>	<p>As shown in the Report of Investigation ("the N75 Report"), attached as Exhibit 8, Nokia's N75 device performs a method for power control in a wireless code division multiple access communication system. <i>See, e.g.,</i> Exhibit 8, § 3.3.1. Nokia advertises on its website that the N75 device uses WCDMA wireless technology. <i>See, e.g.,</i> Exhibit 9.</p>
<p>transmitting dynamically selected code signals at increasing power levels until an acknowledgement is received indicating that one of said dynamically selected code signals was detected,</p>	<p>The N75 device transmits dynamically selected code signals at increasing power levels until an acknowledgement is received indicating that one of the dynamically selected code signals was detected. <i>See, e.g.,</i> Exhibit 8, § 3.3.1.2.</p> <p>For example, the N75 device transmits a series of preambles 1 through 10 at increasing power levels on a Random Access Channel (RACH). <i>See, Exhibit 8, Figure 12, page 23. Table 16 in the N75 Report lists the measured power levels of each transmitted preamble. See, Exhibit 8, page 23.</i></p> <p>Each of preambles 1 through 10 transmitted by the N75 device includes a signature and a scrambling code. According to industry standard for 3G wireless devices, each preamble consists of a signature and a scrambling code. <i>See, e.g.,</i> Exhibit 11, § 4.3.3.1 ("[The random access preamble code] is built from a preamble scrambling code $S_{r_pre,n}$ and a preamble signature $C_{sig,s}$..."). The N75 generates each preamble by dynamically selecting a signature for the preamble. <i>See, e.g.,</i> Exhibit 8, § 3.3.1.3, Table 17, listing the signatures selected by the N75 for each of the preambles 1 through 10. Table 17 in the N75 Report shows that, for example, preamble 1 includes a signature with an index value of 5, preamble 2 includes a signature with an index value of 7, and preamble 3 includes a signature with an index value of 1, etc. <i>See also, e.g.,</i> Exhibit 8, pages 95-99, showing the signature in the preamble content for each transmitted preamble.</p> <p>Further, the N75 transmits preambles 1 through 10 until it receives on an acquisition indicator channel (AICH) an acknowledgement from the base station in the form of an acquisition indicator signal having value of +1, i.e., a positive acknowledgment. <i>See, e.g.,</i> Exhibit 8, § 3.3.1.2.</p>

EXHIBIT 6
INFRINGEMENT OF U.S. PATENT NO. 7,117,004 - Nokia N75

CLAIM 1	INTERDIGITAL'S INFRINGEMENT PROOFS
	<p>Report of Investigation of Nokia N75 (Exhibit 8) Web Page From Nokia's Website (Exhibit 9) 3GPP TS 25.211, Version 3.12.0, Release 1999 (Exhibit 10) 3GPP TS 25.213, Version 3.9.0, Release 1999 (Exhibit 11)</p>
<p>wherein the transmitted dynamically selected code signals carry no data; and</p>	<p>According to 3G industry standard, receipt of the positive acknowledgment by the N75 indicates that preamble 10 is detected by the base station. <i>See, e.g.,</i> Exhibit 10, § 5.3.3.7 ("acquisition indicator correspond[s] to signature s [in the preamble]....").</p> <p>The dynamically selected code signals transmitted by the N75 carry no data.</p> <p>For example, the preambles 1 through 10 transmitted by the N75 do not carry data, as each preamble consists of only a signature and a scrambling code. <i>See, e.g.,</i> Exhibit 11, § 4.3.3.1. The content of each preamble is shown in Annex B.7 of the N75 Report on pages 95-99.</p>
<p>in response to detecting the acknowledgment, transmitting an access signal wherein the access signal is associated with the dynamically selected code signals and</p>	<p>In response to the acknowledgement, the N75 transmits an access signal that is associated with the dynamically selected code signals.</p> <p>For example, in response to the positive acknowledgment detected after transmitting preamble 10, the N75 transmits an access signal in the form of a RACH message. <i>See, e.g.,</i> Exhibit 8, § 3.3.1.2. The RACH message, which includes a scrambling code, is associated with the preambles 1 through 10 through the scrambling code in each preamble. 3G industry standard requires that the scrambling code in the RACH message to have a one-to-one correspondence to the scrambling code in each preamble 1 through 10. <i>See, e.g.,</i> Exhibit 11, § 4.3.2.5 ("The [RACH] message part scrambling code has a one-to-one correspondence to the scrambling code used for the preamble part.").</p>
<p>each of the dynamically selected code signals are shorter than the access signal.</p>	<p>Each of the dynamically selected code signals transmitted by the N75 is shorter than the access signal.</p> <p>For example, each of the preambles 1 through 10 transmitted by the N75 is shorter in duration than the RACH message. <i>See, e.g.,</i> Exhibit 8, § 3.3.1.5. The time duration of each preamble is measured to be approximately 673 μs, whereas the time duration of the RACH message is measured to be approximately 20 ms. <i>See, Exhibit 8, § 3.3.1.5; see also, Exhibit 8, § 3.3.1.2.</i></p>

EXHIBIT 7
INFRINGEMENT OF U.S. PATENT NO. 7,190,966 - Nokia N75

CLAIM 1	INTERDIGITAL'S INFRINGEMENT PROOFS
1. A wireless code division multiple access (CDMA) subscriber unit comprising:	<p>Report of Investigation of Nokia N75 (Exhibit 8) Web Page From Nokia's Website (Exhibit 9) 3GPP TS 25.211, Version 3.12.0, Release 1999 (Exhibit 10) 3GPP TS 25.213, Version 3.9.0, Release 1999 (Exhibit 11) 3GPP TS 25.301, Version 3.11.0, Release 1999 (Exhibit 12)</p>
<p>a transmitter configured such that, when the subscriber unit is first accessing a CDMA network and wants to establish communications with a base station associated with the network over a communication channel to be indicated by the base station, the transmitter successively transmits signals until the subscriber unit receives from the base station an indication that a transmitted one of the signals has been detected by the base station, wherein each transmission of one of the signals by the transmitter is at an increased power level with respect to a prior transmission of one of the signals;</p>	<p>As shown in the Report of Investigation ("the N75 Report"), attached as Exhibit 8, Nokia's N75 device is a code division multiple access subscriber unit. <i>See, e.g.,</i> Exhibit 8, § 1.2. Nokia advertises on its website that the N75 device is a WCDMA wireless device. <i>See, e.g.,</i> Exhibit 9.</p> <p>The N75 device includes a transmitter, which, when the N75 is first accessing a CDMA network and wants to establish communications with a base station over a communication channel to be indicated by the base station, successively transmits signals until the N75 receives from the base station an indication that one of the signals has been detected by the base station. <i>See, e.g.,</i> Exhibit 8, § 3.3.1.2.</p> <p>For example, the N75 transmits a series of preambles 1 through 10 over a Random Access Channel (RACH). <i>See, Exhibit 8, Figure 12, page 23. See also, Exhibit 12, § 5.2.1.1 (describing use of the RACH for initial access to the system). Further, the N75 transmits preambles 1 through 10 until it receives on an acquisition indicator channel (AICH) an indication from the base station, in the form of an acquisition indicator signal having value of +1, i.e., a positive acknowledgment. The positive acknowledgment indicates that one of the preambles has been detected by the base station. See, e.g., Exhibit 8, § 3.3.1.2. According to 3G industry standard, receipt of the positive acknowledgment by the N75 indicates that preamble 10 is detected by the base station. See, e.g., Exhibit 10, § 5.3.3.7 ("acquisition indicator correspond[s] to signature s [in the preamble]....").</i></p> <p>Each of the preambles transmitted by the N75 is at an increased power level with respect to a prior transmission of the preamble.</p> <p>For example, the N75 transmits preamble 1 at -28.66 dBm, preamble 2 at -25.67 dBm, and preamble 3 at -22.70 dBm.</p>

EXHIBIT 7
INFRINGEMENT OF U.S. PATENT NO. 7,190,966 - Nokia N75

CLAIM 1	INTERDIGITAL'S INFRINGEMENT PROOFS
	<p>Report of Investigation of Nokia N75 (Exhibit 8)</p> <p>Web Page From Nokia's Website (Exhibit 9)</p> <p>3GPP TS 25.211, Version 3.12.0, Release 1999 (Exhibit 10)</p> <p>3GPP TS 25.213, Version 3.9.0, Release 1999 (Exhibit 11)</p> <p>3GPP TS 25.301, Version 3.11.0, Release 1999 (Exhibit 12)</p>
<p>the transmitter further configured such that the transmitter transmits to the base station a message indicating to the base station that the subscriber unit wants to establish the communications with the base station over the communication channel to be indicated by the base station, the message being transmitted only subsequent to the subscriber unit receiving the indication,</p>	<p>Table 16 in the N75 Report lists the measured power levels of each transmitted preambles 1 through 10. <i>See</i>, Exhibit 8, page 23.</p> <p>The N75 includes a transmitter that transmits to the base station a message indicating to the base station that the N75 wants to establish communications with the base station over the communication channel to be indicated by the base station.</p> <p>For example, after transmitting preamble 10 and in response to the positive acknowledgement received from the base station on the AICH, the N75 transmits an access signal in the form of a RACH message. <i>See, e.g.</i>, Exhibit 8, § 3.3.1.2. The RACH message includes an RRC Connection Request message, which indicates that the N75 wants to establish communications with the base station over the communication channel to be indicated by the base station. <i>See, e.g.</i>, Exhibit 8, Fig. 15 at page 26.</p> <p>The N75 transmits the message only subsequent to receiving the indication from the base station.</p> <p>For example, the N75 transmits the RACH message only subsequent to receiving the positive acknowledgement. <i>See, e.g.</i>, Exhibit 8, § 3.3.2.1 (showing no transmission of RACH message following a negative acknowledgement).</p>
<p>wherein each of the successively transmitted signals and the message are generated using a same code; and</p>	<p>Each of the successively transmitted signals and the message transmitted by the N75 are generated using the same code.</p> <p>For example, the N75 generates each of the preambles 1 through 10 and the RACH message using the code $c_{long,1,n}$. <i>See, e.g.</i>, Exhibit 11, § 4.3.3.2 and 4.3.2.5.</p> <p>Each preamble includes a signature and a scrambling code. According to 3G industry standard, each preamble consists of</p>

EXHIBIT 7
INFRINGEMENT OF U.S. PATENT NO. 7,190,966 - Nokia N75

CLAIM 1	INTERDIGITAL'S INFRINGEMENT PROOFS
	<p>Report of Investigation of Nokia N75 (Exhibit 8) Web Page From Nokia's Website (Exhibit 9) 3GPP TS 25.211, Version 3.12.0, Release 1999 (Exhibit 10) 3GPP TS 25.213, Version 3.9.0, Release 1999 (Exhibit 11) 3GPP TS 25.301, Version 3.11.0, Release 1999 (Exhibit 12)</p> <p>a signature and a scrambling code. <i>See, e.g.,</i> Exhibit 11, § 4.3.3.1 ("[The random access preamble code] is built from a preamble scrambling code $S_{r-pre,n}$ and a preamble signature $C_{sig,s}...$"). Further, 3G standard requires that the scrambling code for each of the preambles be generated using the code $C_{long,1,n}$. <i>See, e.g.,</i> Exhibit 11, § 4.3.3.2.</p> <p>The N75 generates the RACH message, which includes a scrambling code, using the same code that is used to generate the scrambling code of each of the preambles 1 through 10. 3G industry standard requires that the scrambling code in the RACH message be generated using $C_{long,1,n}$. <i>See, e.g.,</i> Exhibit 11, §§ 4.3.2.2 and 4.3.2.5 (describing the generation of the scrambling code for the RACH message).</p>
wherein each of the successively transmitted signals is shorter than the message.	<p>Each of the signals successively transmitted by the N75 is shorter than the message.</p> <p>For example, each of the preambles 1 through 10 transmitted by the N75 is shorter in duration than the RACH message. <i>See, e.g.,</i> Exhibit 8, § 3.3.1.5. The time duration of each preamble is measured to be approximately 673 μs, whereas the time duration of the RACH message is measured to be approximately 20 ms. <i>See, Exhibit 8, § 3.3.1.5; see also, Exhibit 8, § 3.3.1.2.</i></p>

ETSI TS 125 211 V3.12.0 (2002-09)

Technical Specification

**Universal Mobile Telecommunications System (UMTS);
Physical channels and mapping of transport channels
onto physical channels (FDD)
(3GPP TS 25.211 version 3.12.0 Release 1999)**



3GPP TS 25.211 version 3.12.0 Release 1999

1

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Foreword

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Foreword

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1 Scope

The present document describes the characteristics of the Layer 1 transport channels and physical channels in the FDD mode of UTRA. The main objectives of the document are to be a part of the full description of the UTRA Layer 1, and to serve as a basis for the drafting of the actual technical specification (TS).

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TS 25.201: "Physical layer - general description".
- [2] 3GPP TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)".
- [3] 3GPP TS 25.212: "Multiplexing and channel coding (FDD)".
- [4] 3GPP TS 25.213: "Spreading and modulation (FDD)".
- [5] 3GPP TS 25.214: "Physical layer procedures (FDD)".
- [6] 3GPP TS 25.221: "Transport channels and physical channels (TDD)".
- [7] 3GPP TS 25.222: "Multiplexing and channel coding (TDD)".
- [8] 3GPP TS 25.223: "Spreading and modulation (TDD)".
- [9] 3GPP TS 25.224: "Physical layer procedures (TDD)".
- [10] 3GPP TS 25.215: "Physical layer - Measurements (FDD)".
- [11] 3GPP TS 25.301: "Radio Interface Protocol Architecture".
- [12] 3GPP TS 25.302: "Services Provided by the Physical Layer".
- [13] 3GPP TS 25.401: "UTRAN Overall Description".
- [14] 3GPP TS 25.133: "Requirements for Support of Radio Resource Management (FDD)".
- [15] 3G TS 25.427: "UTRAN Overall Description :UTRA Iub/Iur Interface User Plane Protocol for DCH data streams".
- [16] 3GPP TS 25.435: "UTRAN Iub Interface User Plane Protocols for Common Transport Channel Data Streams".

3 Symbols and abbreviations

3.1 Symbols

N_{data1}	The number of data bits per downlink slot in Data1 field.
N_{data2}	The number of data bits per downlink slot in Data2 field. If the slot format does not contain a Data2 field, $N_{data2} = 0$.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AI	Acquisition Indicator
AICH	Acquisition Indicator Channel
AP	Access Preamble
AP-AICH	Access Preamble Acquisition Indicator Channel
API	Access Preamble Indicator
BCH	Broadcast Channel
CA	Channel Assignment
CAI	Channel Assignment Indicator
CCC	CPCH Control Command
CCPCH	Common Control Physical Channel
CCTrCH	Coded Composite Transport Channel
CD	Collision Detection
CD/CA-ICH	Collision Detection/Channel Assignment Indicator Channel
CDI	Collision Detection Indicator
CPCH	Common Packet Channel
CPICH	Common Pilot Channel
CSICH	CPCH Status Indicator Channel
DCH	Dedicated Channel
DPCCH	Dedicated Physical Control Channel
DPCH	Dedicated Physical Channel
DPDCH	Dedicated Physical Data Channel
DSCH	Downlink Shared Channel
DSMA-CD	Digital Sense Multiple Access - Collision Detection
DTX	Discontinuous Transmission
FACH	Forward Access Channel
FBI	Feedback Information
FSW	Frame Synchronization Word
ICH	Indicator Channel
MUI	Mobile User Identifier
PCH	Paging Channel
P-CCPCH	Primary Common Control Physical Channel
PCPCH	Physical Common Packet Channel
PDSCH	Physical Downlink Shared Channel
PICH	Page Indicator Channel
PRACH	Physical Random Access Channel
PSC	Primary Synchronisation Code
RACH	Random Access Channel
RNC	Radio Network Controller
S-CCPCH	Secondary Common Control Physical Channel
SCH	Synchronisation Channel
SF	Spreading Factor
SFN	System Frame Number
SI	Status Indicator
SSC	Secondary Synchronisation Code
STTD	Space Time Transmit Diversity
TFCI	Transport Format Combination Indicator
TSTD	Time Switched Transmit Diversity
TPC	Transmit Power Control

UE User Equipment
UTRAN UMTS Terrestrial Radio Access Network

4 Services offered to higher layers

4.1 Transport channels

Transport channels are services offered by Layer 1 to the higher layers. General concepts about transport channels are described in [12].

A transport channel is defined by how and with what characteristics data is transferred over the air interface. A general classification of transport channels is into two groups:

- Dedicated channels, using inherent addressing of UE;
- Common channels, using explicit addressing of UE if addressing is needed.

4.1.1 Dedicated transport channels

There exists only one type of dedicated transport channel, the Dedicated Channel (DCH).

4.1.1.1 DCH - Dedicated Channel

The Dedicated Channel (DCH) is a downlink or uplink transport channel. The DCH is transmitted over the entire cell or over only a part of the cell using e.g. beam-forming antennas.

4.1.2 Common transport channels

There are six types of common transport channels: BCH, FACH, PCH, RACH, CPCH and DSCH.

4.1.2.1 BCH - Broadcast Channel

The Broadcast Channel (BCH) is a downlink transport channel that is used to broadcast system- and cell-specific information. The BCH is always transmitted over the entire cell and has a single transport format.

4.1.2.2 FACH - Forward Access Channel

The Forward Access Channel (FACH) is a downlink transport channel. The FACH is transmitted over the entire cell. The FACH can be transmitted using power setting described in [16].

4.1.2.3 PCH - Paging Channel

The Paging Channel (PCH) is a downlink transport channel. The PCH is always transmitted over the entire cell. The transmission of the PCH is associated with the transmission of physical-layer generated Paging Indicators, to support efficient sleep-mode procedures.

4.1.2.4 RACH - Random Access Channel

The Random Access Channel (RACH) is an uplink transport channel. The RACH is always received from the entire cell. The RACH is characterized by a collision risk and by being transmitted using open loop power control.

4.1.2.5 CPCH - Common Packet Channel

The Common Packet Channel (CPCH) is an uplink transport channel. CPCH is associated with a dedicated channel on the downlink which provides power control and CPCH Control Commands (e.g. Emergency Stop) for the uplink CPCH. The CPCH is characterised by initial collision risk and by being transmitted using inner loop power control.

4.1.2.6 DSCH - Downlink Shared Channel

The Downlink Shared Channel (DSCH) is a downlink transport channel shared by several UEs. The DSCH is associated with one or several downlink DCH. The DSCH is transmitted over the entire cell or over only a part of the cell using e.g. beam-forming antennas.

4.2 Indicators

Indicators are means of fast low-level signalling entities which are transmitted without using information blocks sent over transport channels. The meaning of indicators is specific to the type of indicator.

The indicators defined in the current version of the specifications are: Acquisition Indicator (AI), Access Preamble Indicator (API), Channel Assignment Indicator (CAI), Collision Detection Indicator (CDI), Page Indicator (PI) and Status Indicator (SI).

Indicators may be either boolean (two-valued) or three-valued. Their mapping to indicator channels is channel specific.

Indicators are transmitted on those physical channels that are indicator channels (ICH).

5 Physical channels and physical signals

Physical channels are defined by a specific carrier frequency, scrambling code, channelization code (optional), time start & stop (giving a duration) and, on the uplink, relative phase (0 or $\pi/2$). Scrambling and channelization codes are specified in [4]. Time durations are defined by start and stop instants, measured in integer multiples of chips. Suitable multiples of chips also used in specification are:

- Radio frame: A radio frame is a processing duration which consists of 15 slots. The length of a radio frame corresponds to 38400 chips.
- Slot: A slot is a duration which consists of fields containing bits. The length of a slot corresponds to 2560 chips.

The default time duration for a physical channel is continuous from the instant when it is started to the instant when it is stopped. Physical channels that are not continuous will be explicitly described.

Transport channels are described (in more abstract higher layer models of the physical layer) as being capable of being mapped to physical channels. Within the physical layer itself the exact mapping is from a composite coded transport channel (CCTrCH) to the data part of a physical channel. In addition to data parts there also exist channel control parts and physical signals.

5.1 Physical signals

Physical signals are entities with the same basic on-air attributes as physical channels but do not have transport channels or indicators mapped to them. Physical signals may be associated with physical channels in order to support the function of physical channels.

5.2 Uplink physical channels

5.2.1 Dedicated uplink physical channels

There are two types of uplink dedicated physical channels, the uplink Dedicated Physical Data Channel (uplink DPDCH) and the uplink Dedicated Physical Control Channel (uplink DPCCH).

The DPDCH and the DPCCH are I/Q code multiplexed within each radio frame (see [4]).

The uplink DPDCH is used to carry the DCH transport channel. There may be zero, one, or several uplink DPDCHs on each radio link.

The uplink DPCCH is used to carry control information generated at Layer 1. The Layer 1 control information consists of known pilot bits to support channel estimation for coherent detection, transmit power-control (TPC) commands, feedback information (FBI), and an optional transport-format combination indicator (TFCI). The transport-format combination indicator informs the receiver about the instantaneous transport format combination of the transport channels mapped to the simultaneously transmitted uplink DPDCH radio frame. There is one and only one uplink DPCCH on each radio link.

Figure 1 shows the frame structure of the uplink dedicated physical channels. Each radio frame of length 10 ms is split into 15 slots, each of length $T_{slot} = 2560$ chips, corresponding to one power-control period.

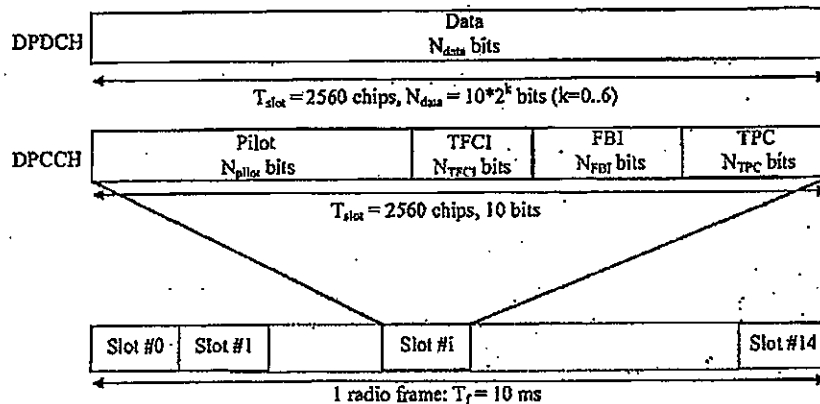


Figure 1: Frame structure for uplink DPDCH/DPCCH

The parameter k in figure 1 determines the number of bits per uplink DPDCH slot. It is related to the spreading factor SF of the DPDCH as $SF = 256/2^k$. The DPDCH spreading factor may range from 256 down to 4. The spreading factor of the uplink DPCCH is always equal to 256, i.e. there are 10 bits per uplink DPCCH slot.

The exact number of bits of the uplink DPDCH and the different uplink DPCCH fields (N_{pilot} , N_{TFCI} , N_{FBI} , and N_{TPC}) is given by table 1 and table 2. What slot format to use is configured by higher layers and can also be reconfigured by higher layers.

The channel bit and symbol rates given in table 1 and table 2 are the rates immediately before spreading. The pilot patterns are given in table 3 and table 4, the TPC bit pattern is given in table 5.

The FBI bits are used to support techniques requiring feedback from the UE to the UTRAN Access Point, including closed loop mode transmit diversity and site selection diversity transmission (SSDT). The structure of the FBI field is shown in figure 2 and described below.

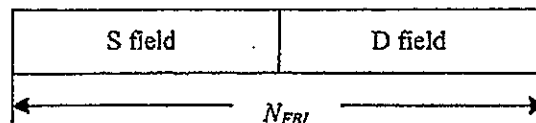


Figure 2: Details of FBI field

The S field is used for SSDT signalling, while the D field is used for closed loop mode transmit diversity signalling. The S field consists of 0, 1 or 2 bits. The D field consists of 0 or 1 bit. The total FBI field size N_{FBI} is given by table 2. If total FBI field is not filled with S field or D field, FBI field shall be filled with "1". When N_{FBI} is 2 bits, S field is 0 bit and D field is 1 bit, left side field shall be filled with "1" and right side field shall be D field. The use of the FBI fields is described in detail in [5].

Table 1: DPDCH fields

Slot Format #	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/ Frame	Bits/ Slot	N _{data}
0	15	15	256	150	10	10
1	30	30	128	300	20	20
2	60	60	64	600	40	40
3	120	120	32	1200	80	80
4	240	240	16	2400	160	160
5	480	480	8	4800	320	320
6	960	960	4	9600	640	640

There are two types of uplink dedicated physical channels; those that include TFCI (e.g. for several simultaneous services) and those that do not include TFCI (e.g. for fixed-rate services). These types are reflected by the duplicated rows of table 2. It is the UTRAN that determines if a TFCI should be transmitted and it is mandatory for all UEs to support the use of TFCI in the uplink. The mapping of TFCI bits onto slots is described in [3].

In compressed mode, DPCCH slot formats with TFCI fields are changed. There are two possible compressed slot formats for each normal slot format. They are labelled A and B and the selection between them is dependent on the number of slots that are transmitted in each frame in compressed mode.

Table 2: DPCCH fields

Slot Form at #i	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/ Frame	Bits/ Slot	N _{pilot}	N _{TPC}	N _{TFCI}	N _{FBI}	Transmitted slots per radio frame
0	15	15	256	150	10	6	2	2	0	15
0A	15	15	256	150	10	5	2	3	0	10-14
0B	15	15	256	150	10	4	2	4	0	8-9
1	15	15	256	150	10	8	2	0	0	8-15
2	15	15	256	150	10	5	2	2	1	15
2A	15	15	256	150	10	4	2	3	1	10-14
2B	15	15	256	150	10	3	2	4	1	8-9
3	15	15	256	150	10	7	2	0	1	8-15
4	15	15	256	150	10	6	2	0	2	8-15
5	15	15	256	150	10	5	1	2	2	15
5A	15	15	256	150	10	4	1	3	2	10-14
5B	15	15	256	150	10	3	1	4	2	8-9

The pilot bit patterns are described in table 3 and table 4. The shadowed column part of pilot bit pattern is defined as FSW and FSWs can be used to confirm frame synchronization. (The value of the pilot bit pattern other than FSWs shall be "1".)

Table 3: Pilot bit patterns for uplink DPCCH with N_{pilot} = 3, 4, 5 and 6

	N _{pilot} = 3			N _{pilot} = 4			N _{pilot} = 5			N _{pilot} = 6				
Bit #	0	1	2	0	1	2	0	1	2	3	0	1	2	3
Slot #0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4: Pilot bit patterns for uplink DPCCH with $N_{\text{pilot}} = 7$ and 8

	$N_{\text{pilot}} = 7$						$N_{\text{pilot}} = 8$								
Bit #	0	1	2	3	4	5	6	0	1	2	3	4	5	6	7
Slot #0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

The relationship between the TPC bit pattern and transmitter power control command is presented in table 5.

Table 5: TPC Bit Pattern

TPC Bit Pattern		Transmitter power control command
$N_{\text{TPC}} = 1$	$N_{\text{TPC}} = 2$	
1	11	1
0	00	0

Multi-code operation is possible for the uplink dedicated physical channels. When multi-code transmission is used, several parallel DPDCH are transmitted using different channelization codes, see [4]. However, there is only one DPCCH per radio link.

A period of uplink DPCCH transmission prior to the start of the uplink DPDCH transmission (uplink DPCCH power control preamble) shall be used for initialisation of a DCH. The length of the power control preamble is a higher layer parameter, N_{pcp} , signalled by the network [5]. The UL DPCCH shall take the same slot format in the power control preamble as afterwards, as given in table 2. When $N_{\text{pcp}} > 0$ the pilot patterns of table 3 and table 4 shall be used. The timing of the power control preamble is described in [5], subclause 4.3.2.3. The TFCI field is filled with "0" bits.

5.2.2 Common uplink physical channels

5.2.2.1 Physical Random Access Channel (PRACH)

The Physical Random Access Channel (PRACH) is used to carry the RACH.

5.2.2.1.1 Overall structure of random-access transmission

The random-access transmission is based on a Slotted ALOHA approach with fast acquisition indication. The UE can start the random-access transmission at the beginning of a number of well-defined time intervals, denoted *access slots*. There are 15 access slots per two frames and they are spaced 5120 chips apart, see figure 3. The timing of the access slots and the acquisition indication is described in subclause 7.3. Information on what access slots are available for random-access transmission is given by higher layers.

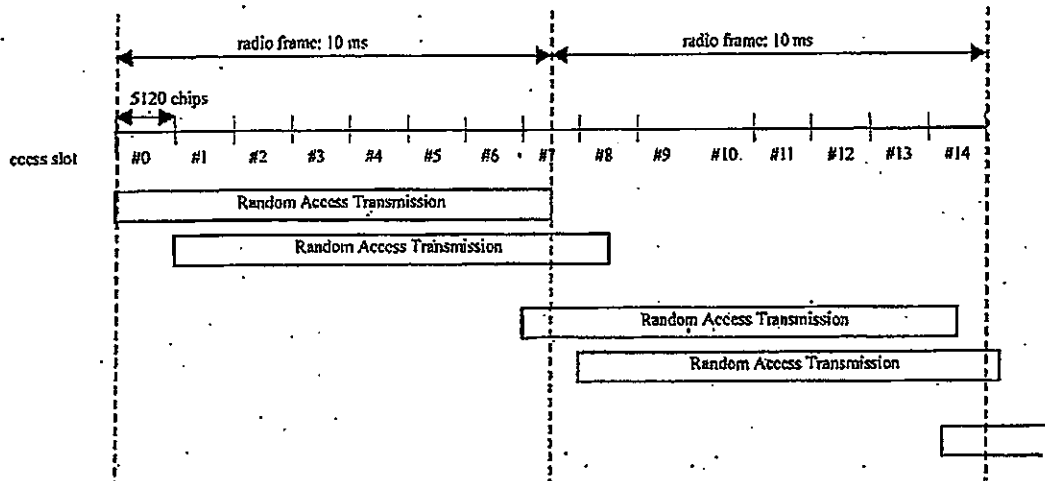


Figure 3: RACH access slot numbers and their spacing

The structure of the random-access transmission is shown in figure 4. The random-access transmission consists of one or several *preambles* of length 4096 chips and a *message* of length 10 ms or 20 ms.

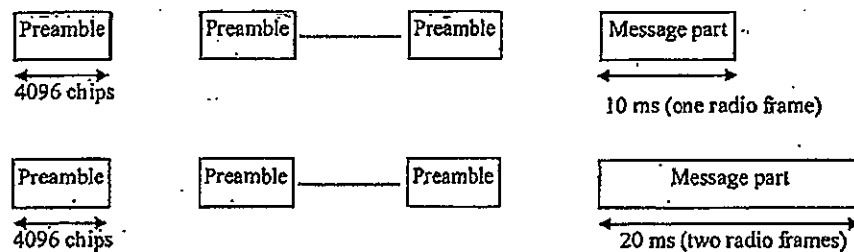


Figure 4: Structure of the random-access transmission

5.2.2.1.2 RACH preamble part

Each preamble is of length 4096 chips and consists of 256 repetitions of a signature of length 16 chips. There are a maximum of 16 available signatures, see [4] for more details.

5.2.2.1.3 RACH message part

Figure 5 shows the structure of the random-access message part radio frame. The 10 ms message part radio frame is split into 15 slots, each of length $T_{slot} = 2560$ chips. Each slot consists of two parts, a data part to which the RACH transport channel is mapped and a control part that carries Layer 1 control information. The data and control parts are transmitted in parallel. A 10 ms message part consists of one message part radio frame, while a 20 ms message part consists of two consecutive 10 ms message part radio frames. The message part length is equal to the Transmission Time Interval of the RACH Transport channel in use. This TTI length is configured by higher layers.

The data part consists of $10 \cdot 2^k$ bits, where $k=0,1,2,3$. This corresponds to a spreading factor of 256, 128, 64, and 32 respectively for the message data part.

The control part consists of 8 known pilot bits to support channel estimation for coherent detection and 2 TFCI bits. This corresponds to a spreading factor of 256 for the message control part. The pilot bit pattern is described in table 8. The total number of TFCI bits in the random-access message is $15 \cdot 2 = 30$. The TFCI of a radio frame indicates the transport format of the RACH transport channel mapped to the simultaneously transmitted message part radio frame. In case of a 20 ms PRACH message part, the TFCI is repeated in the second radio frame.

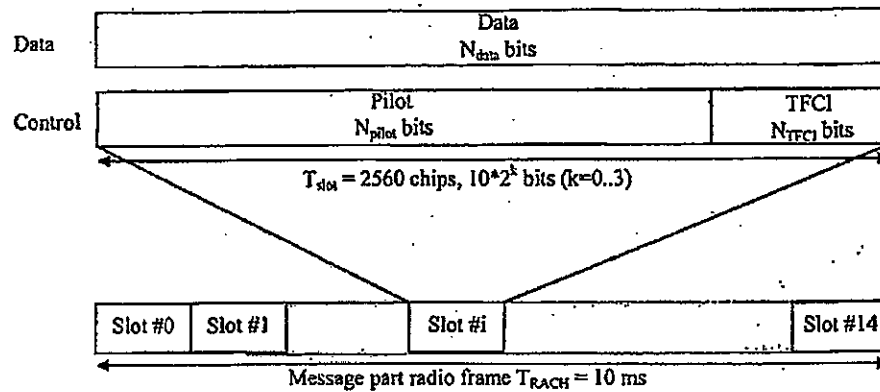


Figure 5: Structure of the random-access message part radio frame

Table 6: Random-access message data fields

Slot Format #1	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/ Frame	Bits/ Slot	N_{data}
0	15	15	256	150	10	10
1	30	30	128	300	20	20
2	60	60	64	600	40	40
3	120	120	32	1200	80	80

Table 7: Random-access message control fields

Slot Format #1	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/ Frame	Bits/ Slot	N_{pilot}	N_{TFCI}
0	15	15	256	150	10	8	2

Table 8: Pilot bit patterns for RACH message part with $N_{pilot} = 8$

Bit #	$N_{pilot} = 8$							
	0	1	2	3	4	5	6	7
Slot #0	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1	1
7	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1	1
14	1	1	1	1	1	1	1	1

5.2.2.2 Physical Common Packet Channel (PCPCH)

The Physical Common Packet Channel (PCPCH) is used to carry the CPCH.

5.2.2.2.1 CPCH transmission

The CPCH transmission is based on DSMA-CD approach with fast acquisition indication. The UE can start transmission at the beginning of a number of well-defined time-intervals, relative to the frame boundary of the received BCH of the current cell. The access slot timing and structure is identical to RACH in subclause 5.2.2.1.1. The structure of the CPCH access transmission is shown in figure 6. The CPCH access transmission consists of one or several Access Preambles [A-P] of length 4096 chips, one Collision Detection Preamble (CD-P) of length 4096 chips, a DPCCCH Power Control Preamble (PC-P) which is either 0 slots or 8 slots in length, and a message of variable length $N \times 10$ ms.

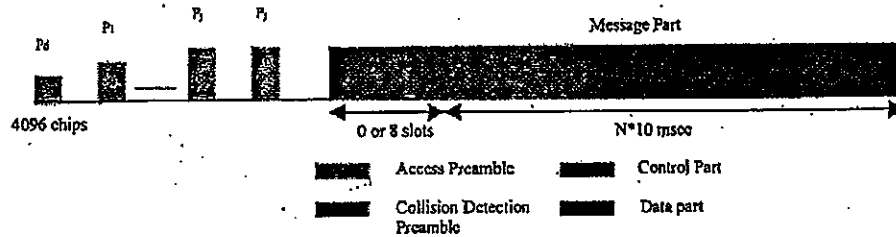


Figure 6: Structure of the CPCH access transmission

5.2.2.2.2 CPCH access preamble part

Similar to 5.2.2.1.2 (RACH preamble part). The RACH preamble signature sequences are used. The number of sequences used could be less than the ones used in the RACH preamble. The scrambling code could either be chosen to be a different code segment of the Gold code used to form the scrambling code of the RACH preambles (see [4] for more details) or could be the same scrambling code in case the signature set is shared.

5.2.2.2.3 CPCH collision detection preamble part

Similar to 5.2.2.1.2 (RACH preamble part). The RACH preamble signature sequences are used. The scrambling code is chosen to be a different code segment of the Gold code used to form the scrambling code for the RACH and CPCH preambles (see [4] for more details).

5.2.2.2.4 CPCH power control preamble part

The power control preamble segment is called the CPCH Power Control Preamble (PC-P) part. The slot format for CPCH PC-P part shall be the same as for the following message part in Table 9 in subclause 5.2.2.2.5. The Power Control Preamble length is a higher layer parameter, $L_{pc-preamble}$ (see [5], section 6.2), which shall take the value 0 or 8 slots. When $L_{pc-preamble} > 0$, the pilot bit patterns from slot # $(15 - L_{pc-preamble})$ to slot #14 of table 3 and 4 in subclause 5.2.1 shall be used for CPCH PC-P pilot bit patterns. The TFCI field is filled with "1" bits.

5.2.2.2.5 CPCH message part

Figure 1 in subclause 5.2.1 shows the structure of the CPCH message part. Each message consists of up to N_{Max_frames} 10 ms frames. N_{Max_frames} is a higher layer parameter. Each 10 ms frame is split into 15 slots, each of length $T_{slot} = 2560$ chips. Each slot consists of two parts, a data part that carries higher layer information and a control part that carries Layer 1 control information. The data and control parts are transmitted in parallel.

The entries of table 1 in subclause 5.2.1 apply to the data part of the CPCH message part. The spreading factor for the control part of the CPCH message part shall be 256. Table 9 defines the slot format of the control part of CPCH message part. The pilot bit patterns of table 3 in subclause 5.2.1 shall be used for pilot bit patterns of the CPCH message part.

Table 9: Slot format of the control part of CPCH message part

Slot Format #i	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/ Frame	Bits/ Slot	N_{pilot}	N_{TPC}	N_{TFCI}	N_{FBI}
0	15	15	256	150	10	6	2	2	0
1	15	15	256	150	10	5	2	2	1

Figure 7 shows the frame structure of the uplink common packet physical channel. Each frame of length 10 ms is split into 15 slots, each of length $T_{\text{slot}} = 2560$ chips, corresponding to one power-control period.

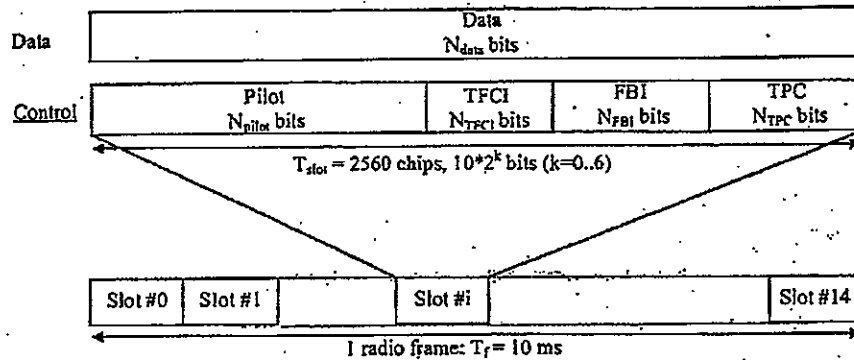


Figure 7: Frame structure for uplink Data and Control Parts Associated with PCPCH

The data part consists of $10 \cdot 2^k$ bits, where $k = 0, 1, 2, 3, 4, 5, 6$, corresponding to spreading factors of 256, 128, 64, 32, 16, 8, 4 respectively.

5.3 Downlink physical channels

5.3.1 Downlink transmit diversity

Table 10 summarizes the possible application of open and closed loop transmit diversity modes on different downlink physical channel types. Simultaneous use of STTD and closed loop modes on the same physical channel is not allowed. In addition, if Tx diversity is applied on any of the downlink physical channels it shall also be applied on P-CCPCH and SCH. Regarding CPICH transmission in case of transmit diversity, see subclause 5.3.3.1.

With respect to the usage of Tx diversity on different radio links within an active set, the following rules apply:

- Different Tx diversity modes (STTD and closed loop) shall not be used on the radio links within one active set.
- No Tx diversity on one or more radio links shall not prevent UTRAN to use Tx diversity on other radio links within the same active set.
- If STTD is activated on one or several radio links in the active set, the UE shall operate STTD either on only those radio links where STTD has been activated or on all radio links in the active set.
- If closed loop TX diversity is activated on one or several radio links in the active set, the UE shall operate closed loop TX diversity either on only those radio links where closed loop TX diversity has been activated or on all radio links in the active set.

Furthermore, the transmit diversity mode used for a PDSCH frame shall be the same as the transmit diversity mode used for the DPCH associated with this PDSCH frame. The transmit diversity mode on the associated DPCH may not change during a PDSCH frame and within the slot prior to the PDSCH frame. This includes any change between no Tx diversity, open loop, closed loop mode 1 or closed loop mode 2.

Table 10: Application of Tx diversity modes on downlink physical channel types
 "X" – can be applied, "-" – not applied

Physical channel type	Open loop mode		Closed loop Mode
	TSTD	STTD	
P-CCPCH	-	X	-
SCH	X	-	-
S-CCPCH	-	X	-
DPCH	-	X	X
PICH	-	X	-
PDSCH	-	X	X
AICH	-	X	-
CSICH	-	X	-
AP-AICH	-	X	-
CD/CA-ICH	-	X	-
DL-DPCCH for CPCH	-	X	X

5.3.1.1 Open loop transmit diversity

5.3.1.1.1 Space time block coding based transmit antenna diversity (STTD)

The open loop downlink transmit diversity employs a space time block coding based transmit diversity (STTD).

The STTD encoding is optional in UTRAN. STTD support is mandatory at the UE.

If higher layers signal that neither P-CPICH nor S-CPICH can be used as phase reference for the downlink DPCH for a radio link in a cell, the UE shall assume that STTD is not used for the downlink DPCH (and the associated PDSCH if applicable) in that cell.

A block diagram of a generic STTD encoder is shown in the figure 8 below. Channel coding, rate matching and interleaving are done as in the non-diversity mode. The STTD encoder operates on 4 symbols b_0, b_1, b_2, b_3 as shown in figure 8. For AICH, AP-AICH and CD/CA-ICH, the b_i are real valued signals, and \bar{b}_i is defined as $-b_i$. For channels other than AICH, AP-AICH and CD/CA-ICH, the b_i are 3-valued digits, taking the values 0, 1, "DTX", and \bar{b}_i is defined as follows: if $b_i = 0$ then $\bar{b}_i = 1$, if $b_i = 1$ then $\bar{b}_i = 0$, otherwise $\bar{b}_i = b_i$.

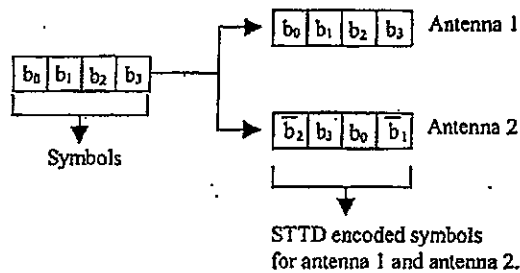


Figure 8: Generic block diagram of the STTD encoder

5.3.1.1.2 Time Switched Transmit Diversity for SCH (TSTD)

Transmit diversity, in the form of Time Switched Transmit Diversity (TSTD), can be applied to the SCH. TSTD for the SCH is optional in UTRAN, while TSTD support is mandatory in the UE. TSTD for the SCH is described in subclause 5.3.3.5.1.

5.3.1.2 Closed loop transmit diversity

Closed loop transmit diversity is described in [5]. Both closed loop transmit diversity modes shall be supported at the UE and may be supported in the UTRAN.

5.3.2 Dedicated downlink physical channels

There is only one type of downlink dedicated physical channel, the Downlink Dedicated Physical Channel (downlink DPCH).

Within one downlink DPCH, dedicated data generated at Layer 2 and above, i.e. the dedicated transport channel (DCH), is transmitted in time-multiplex with control information generated at Layer 1 (known pilot bits, TPC commands, and an optional TFCI). The downlink DPCH can thus be seen as a time multiplex of a downlink DPDCH and a downlink DPCCCH, compare subclause 5.2.1.

Figure 9 shows the frame structure of the downlink DPCH. Each frame of length 10 ms is split into 15 slots, each of length $T_{slot} = 2560$ chips, corresponding to one power-control period.

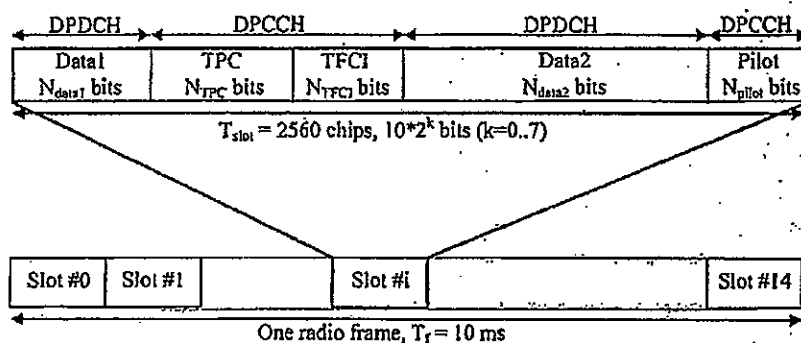


Figure 9: Frame structure for downlink DPCH

The parameter k in figure 9 determines the total number of bits per downlink DPCH slot. It is related to the spreading factor SF of the physical channel as $SF = 512/2^k$. The spreading factor may thus range from 512 down to 4.

The exact number of bits of the different downlink DPCH fields (N_{pilot} , N_{TPC} , N_{TFCI} , N_{data1} and N_{data2}) is given in table 11. What slot format to use is configured by higher layers and can also be reconfigured by higher layers.

There are basically two types of downlink Dedicated Physical Channels; those that include TFCI (e.g. for several simultaneous services) and those that do not include TFCI (e.g. for fixed-rate services). These types are reflected by the duplicated rows of table 11. It is the UTRAN that determines if a TFCI should be transmitted and it is mandatory for all UEs to support the use of TFCI in the downlink. The mapping of TFCI bits onto slots is described in [3].

In compressed frames, a different slot format is used compared to normal mode. There are two possible compressed slot formats that are labelled A and B. Slot format B shall be used in frames compressed by spreading factor reduction and slot format A shall be used in frames compressed by puncturing or higher layer scheduling. The channel bit and symbol rates given in table 11 are the rates immediately before spreading.

Table 11: DPDCH and DPCCH fields

Slot Format #1	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/Slot	DPDCH Bits/Slot		DPCCH Bits/Slot			Transmitted slots per radio frame N_{fr}
					N_{Data1}	N_{Data2}	N_{TPC}	N_{TFCI}	N_{Pilot}	
0	15	7.5	512	10	0	4	2	0	4	15
0A	15	7.5	512	10	0	4	2	0	4	8-14
0B	30	15	256	20	0	8	4	0	8	8-14
1	15	7.5	512	10	0	2	2	2	4	15
1B	30	15	256	20	0	4	4	4	8	8-14
2	30	15	256	20	2	14	2	0	2	15
2A	30	15	256	20	2	14	2	0	2	8-14
2B	60	30	128	40	4	28	4	0	4	8-14
3	30	15	256	20	2	12	2	2	2	15
3A	30	15	256	20	2	10	2	4	2	8-14
3B	60	30	128	40	4	24	4	4	4	8-14
4	30	15	256	20	2	12	2	0	4	15
4A	30	15	256	20	2	12	2	0	4	8-14
4B	60	30	128	40	4	24	4	0	8	8-14
5	30	15	256	20	2	10	2	2	4	15
5A	30	15	256	20	2	8	2	4	4	8-14
5B	60	30	128	40	4	20	4	4	8	8-14
6	30	15	256	20	2	8	2	0	8	15
6A	30	15	256	20	2	8	2	0	8	8-14
6B	60	30	128	40	4	16	4	0	16	8-14
7	30	15	256	20	2	6	2	2	8	15
7A	30	15	256	20	2	4	2	4	8	8-14
7B	60	30	128	40	4	12	4	4	16	8-14
8	60	30	128	40	6	28	2	0	4	15
8A	60	30	128	40	6	28	2	0	4	8-14
8B	120	60	64	80	12	56	4	0	8	8-14
9	60	30	128	40	6	26	2	2	4	15
9A	60	30	128	40	6	24	2	4	4	8-14
9B	120	60	64	80	12	52	4	4	8	8-14
10	60	30	128	40	6	24	2	0	8	15
10A	60	30	128	40	6	24	2	0	8	8-14
10B	120	60	64	80	12	48	4	0	16	8-14
11	60	30	128	40	6	22	2	2	8	15
11A	60	30	128	40	6	20	2	4	8	8-14
11B	120	60	64	80	12	44	4	4	16	8-14
12	120	60	64	80	12	48	4	8*	8	15
12A	120	60	64	80	12	40	4	16*	8	8-14
12B	240	120	32	160	24	96	8	16*	16	8-14
13	240	120	32	160	28	112	4	8*	8	15
13A	240	120	32	160	28	104	4	16*	8	8-14
13B	480	240	16	320	56	224	8	16*	16	8-14
14	480	240	16	320	56	232	8	8*	16	15
14A	480	240	16	320	56	224	8	16*	16	8-14
14B	960	480	8	640	112	464	16	16*	32	8-14
15	960	480	8	640	120	488	8	8*	16	15
15A	960	480	8	640	120	480	8	16*	16	8-14
15B	1920	960	4	1280	240	976	16	16*	32	8-14
16	1920	960	4	1280	248	1000	8	8*	16	15
16A	1920	960	4	1280	248	992	8	16*	16	8-14

* If TFCI bits are not used, then DTX shall be used in TFCI field.

NOTE 1: Compressed mode is only supported through spreading factor reduction for SF=512 with TFCI.

NOTE 2: Compressed mode by spreading factor reduction is not supported for SF=4.

NOTE 3: If the Node B receives an invalid combination of data frames for downlink transmission, the procedure specified in [15], sub-clause 5.1.2, may require the use of DTX in both the DPDCH and the TFCI field of the DPCCH.

The pilot bit patterns are described in table 12. The shadowed column part of pilot bit pattern is defined as FSW and FSWs can be used to confirm frame synchronization. (The value of the pilot bit pattern other than FSWs shall be "11".) In table 12, the transmission order is from left to right.

In downlink compressed mode through spreading factor reduction, the number of bits in the TPC and Pilot fields are doubled. Symbol repetition is used to fill up the fields. Denote the bits in one of these fields in normal mode by $x_1, x_2, x_3, \dots, x_N$. In compressed mode the following bit sequence is sent in corresponding field: $x_1, x_2, x_1, x_2, x_3, x_4, x_3, x_4, \dots, x_N$.

Table 12: Pilot bit patterns for downlink DPCH with $N_{\text{pilot}} = 2, 4, 8$ and 16

Symbol #	$N_{\text{pilot}} = 2$		$N_{\text{pilot}} = 4$ (*1)		$N_{\text{pilot}} = 8$ (*2)				$N_{\text{pilot}} = 16$ (*3)							
	0	1	0	1	0	1	2	3	0	1	2	3	4	5	6	7
Slot #0	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
1	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
2	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
3	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
4	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
5	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
6	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
7	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
8	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
9	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
10	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
12	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
13	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
14	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11

NOTE *1: This pattern is used except slot formats 2B and 3B.

NOTE *2: This pattern is used except slot formats 0B, 1B, 4B, 5B, 8B, and 9B.

NOTE *3: This pattern is used except slot formats 6B, 7B, 10B, 11B, 12B, and 13B.

NOTE: For slot format nB where $n = 0, \dots, 15$, the pilot bit pattern corresponding to $N_{\text{pilot}}/2$ is to be used and symbol repetition shall be applied.

The relationship between the TPC symbol and the transmitter power control command is presented in table 13.

Table 13: TPC Bit Pattern

TPC Bit Pattern			Transmitter power control command
$N_{\text{TPC}} = 2$	$N_{\text{TPC}} = 4$	$N_{\text{TPC}} = 8$	
11	1111	11111111	1
00	0000	00000000	0

Multicode transmission may be employed in the downlink, i.e. the CCTrCH (see [3]) is mapped onto several parallel downlink DPCHs using the same spreading factor. In this case, the Layer 1 control information is transmitted only on the first downlink DPCH. DTX bits are transmitted during the corresponding time period for the additional downlink DPCHs, see figure 10.

In case there are several CCTrCHs mapped to different DPCHs transmitted to the same UE different spreading factors can be used on DPCHs to which different CCTrCHs are mapped. Also in this case, Layer 1 control information is only transmitted on the first DPCH while DTX bits are transmitted during the corresponding time period for the additional DPCHs.

Note: support of multiple CCTrCHs of dedicated type is not part of the current release.

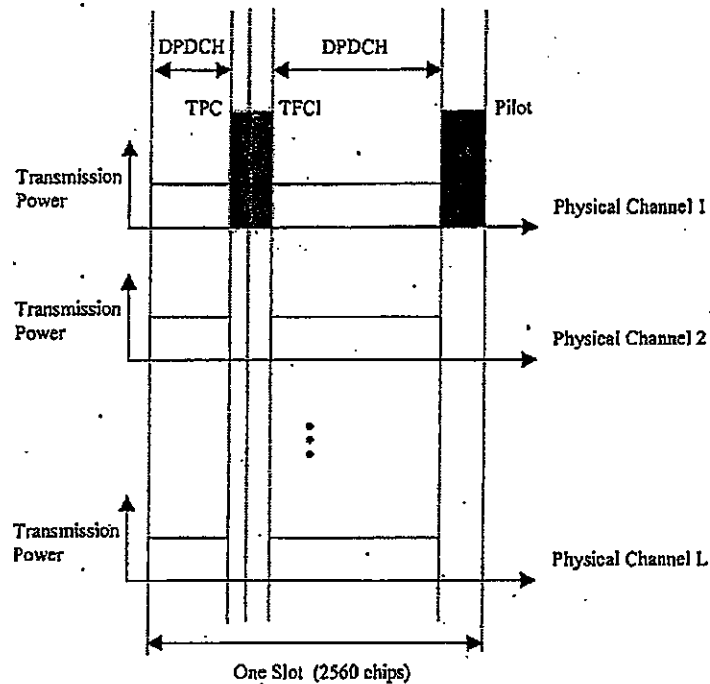


Figure 10: Downlink slot format in case of multi-code transmission

5.3.2.1 STTD for DPCH

The pilot bit pattern for the DPCH channel transmitted on antenna 2 is given in table 14.

- For $N_{\text{pilot}} = 8, 16$ the shadowed part indicates pilot bits that are obtained by STTD encoding the corresponding (shadowed) bits in Table 12. The non-shadowed pilot bit pattern is orthogonal to the corresponding (non-shadowed) pilot bit pattern in table 12.
- For $N_{\text{pilot}} = 4$, the diversity antenna pilot bit pattern is obtained by STTD encoding both the shadowed and non-shadowed pilot bits in table 12.
- For $N_{\text{pilot}} = 2$, the diversity antenna pilot pattern is obtained by STTD encoding the two pilot bits in table 12 with the last two bits (data or DTX) of the second data field (data2) of the slot. Thus for $N_{\text{pilot}} = 2$ case, the last two bits of the second data field (data 2) after STTD encoding, follow the diversity antenna pilot bits in Table 14.

STTD encoding for the DPDCH, TPC, and TFCI fields is done as described in subclause 5.3.1.1.1. For the SF=512 DPCH, the first two bits in each slot, i.e. TPC bits, are not STTD encoded and the same bits are transmitted with equal power from the two antennas. The remaining four bits are STTD encoded.

For compressed mode through spreading factor reduction and for $N_{\text{pilot}} > 4$, symbol repetition shall be applied to the pilot bit patterns of table 14, in the same manner as described in 5.3.2. For slot formats 2B and 3B, i.e. compressed mode through spreading factor reduction and $N_{\text{pilot}} = 4$, the pilot bits transmitted on antenna 2 are STTD encoded, and thus the pilot bit pattern is as shown in the most right set of table 14.

Table 14: Pilot bit patterns of downlink DPCCH for antenna 2 using STTD

	$N_{\text{pilot}} = 2$ (*1)	$N_{\text{pilot}} = 4$ (*2)		$N_{\text{pilot}} = 8$ (*3)			$N_{\text{pilot}} = 16$ (*4)								$N_{\text{pilot}} = 4$ (*5)	
Symbol #	0	0	1	0	1	2	0	1	2	3	4	5	6	7	0	1
Slot #0	01	01	10	11	00	00	11	00	00	10	11	00	00	10	10	10
1	10	10	10	11	00	00	11	00	00	10	11	00	00	10	10	01
2	11	11	10	11	11	00	11	00	00	11	00	00	00	10	10	00
3	10	10	10	11	10	00	11	00	00	11	00	00	00	10	10	01
4	00	00	10	11	11	00	11	00	00	11	00	00	00	10	10	01
5	01	01	10	11	00	00	11	00	00	10	11	00	00	10	10	00
6	01	01	10	11	10	00	11	00	00	10	11	00	00	10	10	01
7	00	00	10	11	10	00	11	00	00	11	00	00	00	10	10	01
8	11	11	10	11	00	00	11	00	00	11	00	00	00	10	10	00
9	01	01	10	11	01	00	11	00	00	10	11	00	00	10	10	01
10	11	11	10	11	11	00	11	00	00	11	00	00	00	10	10	00
11	00	00	10	11	01	00	11	00	00	11	00	00	00	10	10	01
12	00	00	10	11	10	00	11	00	00	11	00	00	00	10	10	01
13	10	10	10	11	01	00	11	00	00	11	00	00	00	10	10	01
14	10	10	10	11	01	00	11	00	00	11	00	00	00	10	10	01

NOTE *1: The pilot bits precede the last two bits of the data2 field.

NOTE *2: This pattern is used except slot formats 2B and 3B.

NOTE *3: This pattern is used except slot formats 0B, 1B, 4B, 5B, 8B, and 9B.

NOTE *4: This pattern is used except slot formats 6B, 7B, 10B, 11B, 12B, and 13B.

NOTE *5: This pattern is used for slot formats 2B and 3B.

NOTE: For slot format nB where $n = 0, 1, 4, 5, 6, \dots, 15$, the pilot bit pattern corresponding to $N_{\text{pilot}}/2$ is to be used and symbol repetition shall be applied.

5.3.2.2 Dedicated channel pilots with closed loop mode transmit diversity

In closed loop mode 1 orthogonal pilot patterns are used between the transmit antennas. Closed loop mode 1 shall not be used with DPCCH slot formats for which $N_{\text{pilot}}=2$. Pilot patterns defined in the table 12 will be used on antenna 1 and pilot patterns defined in the table 15 on antenna 2. This is illustrated in the figure 11 a which indicates the difference in the pilot patterns with different shading.

Table 15: Pilot bit patterns of downlink DPCCH for antenna 2 using closed loop mode 1

		$N_{\text{pilot}} = 4$ (*1)		$N_{\text{pilot}} = 8$ (*1)			$N_{\text{pilot}} = 16$ (*2)								
Symbol #		0	1	0	1	2	0	1	2	3	4	5	6	7	
Slot #0		01	10	11	00	00	11	00	00	10	11	00	00	10	
1		10	10	11	00	00	11	00	00	10	11	00	00	10	
2		10	10	11	00	00	11	00	00	10	11	00	00	10	
3		10	10	11	00	00	11	00	00	10	11	00	00	10	
4		00	10	11	00	00	11	00	00	10	11	00	00	10	
5		00	10	11	00	00	11	00	00	10	11	00	00	10	
6		00	10	11	00	00	11	00	00	10	11	00	00	10	
7		00	10	11	00	00	11	00	00	10	11	00	00	10	
8		00	10	11	00	00	11	00	00	10	11	00	00	10	
9		00	10	11	00	00	11	00	00	10	11	00	00	10	
10		00	10	11	00	00	11	00	00	10	11	00	00	10	
11		00	10	11	00	00	11	00	00	10	11	00	00	10	
12		00	10	11	00	00	11	00	00	10	11	00	00	10	
13		00	10	11	00	00	11	00	00	10	11	00	00	10	
14		00	10	11	00	00	11	00	00	10	11	00	00	10	

NOTE *1: This pattern is used except slot formats 0B, 1B, 4B, 5B, 8B, and 9B.

NOTE *2: This pattern is used except slot formats 6B, 7B, 10B, 11B, 12B, and 13B.

NOTE: For slot format nB where $n = 0, 1, 4, 5, 6, \dots, 15$, the pilot bit pattern corresponding to $N_{\text{pilot}}/2$ is to be used and symbol repetition shall be applied.

In closed loop mode 2 same pilot pattern is used on both of the antennas (see figure 11 b). The pattern to be used is according to the table 12.

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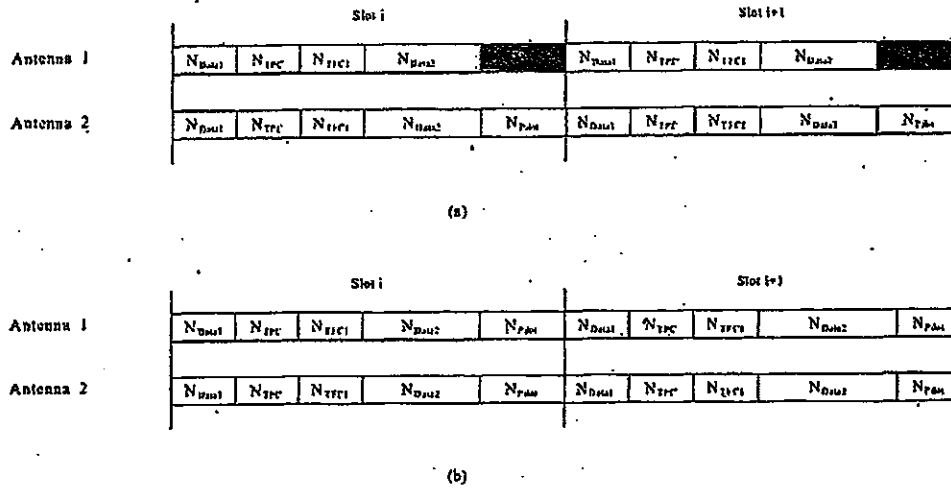


Figure 11: Slot structures for downlink dedicated physical channel diversity transmission.
 Structure (a) is used in closed loop mode 1.
 Structure (b) is used in closed loop mode 2.
 Different shading of the pilots, indicate orthogonality of the patterns

5.3.2.3 DL-DPCCH for CPCH

The downlink DPCCH for CPCH is a special case of downlink dedicated physical channel of the slot format #0 in table 11. The spreading factor for the DL-DPCCH is 512. Figure 12 shows the frame structure of DL-DPCCH for CPCH.

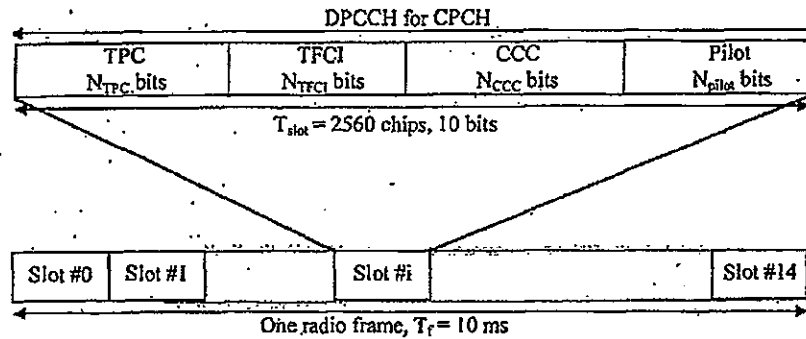


Figure 12: Frame structure for downlink DPCCH for CPCH

DL-DPCCH for CPCH consists of known pilot bits, TFCI, TPC commands and CPCH Control Commands (CCC). CPCH control commands are used to support CPCH signalling. There are two types of CPCH control commands: Layer 1 control command such as Start of Message Indicator, and higher layer control command such as Emergency Stop command. The exact number of bits of DL DPCCH fields (N_{Pilot} , N_{TFCI} , N_{CCC} and N_{TPC}) is determined in table 16. The pilot bit pattern for $N_{Pilot}=4$ of table 12 is used for DPCCH for CPCH.

Table 16: DPCCH fields for CPCH message transmission

Slot Format #i	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/Slot	DPCCH Bits/Slot				Transmitted slots per radio frame N_{Tr}
					N_{TPC}	N_{TFCI}	N_{CCC}	N_{Pilot}	
0	15	7.5	512	10	2	0	4	4	15

The DL DPCCH power control preamble for CPCH shall take the same slot format as afterwards, as given in Table 16. The length of the power control preamble is a higher-layer parameter, $L_{pc-preamble}$ (see [5], section 6.2), signalled by the network. When $L_{pc-preamble} > 0$, the pilot patterns from slot #15 to slot #14 of table 12 shall be used for the power control preamble pilot patterns. The TFCI field is filled with "1" bits.

CCC field in figure 12 is used for the transmission of CPCH control command. On CPCH control command transmission request from higher layer, a certain pattern is mapped onto CCC field, otherwise nothing is transmitted in CCC field. There is one to one mapping between the CPCH control command and the pattern. In case of Emergency Stop of CPCH transmission, [1111] pattern is mapped onto CCC field. The Emergency Stop command shall not be transmitted during the first $N_{Start_Message}$ frames of DL DPCCH after Power Control preamble.

Start of Message Indicator shall be transmitted during the first $N_{Start_Message}$ frames of DL DPCCH after Power Control preamble. [1010] pattern is mapped onto CCC field for Start of Message Indicator. The value of $N_{Start_Message}$ shall be provided by higher layers.

5.3.3 Common downlink physical channels

5.3.3.1 Common Pilot Channel (CPICH)

The CPICH is a fixed rate (30 kbps, $SF=256$) downlink physical channel that carries a pre-defined bit sequence. Figure 13 shows the frame structure of the CPICH.

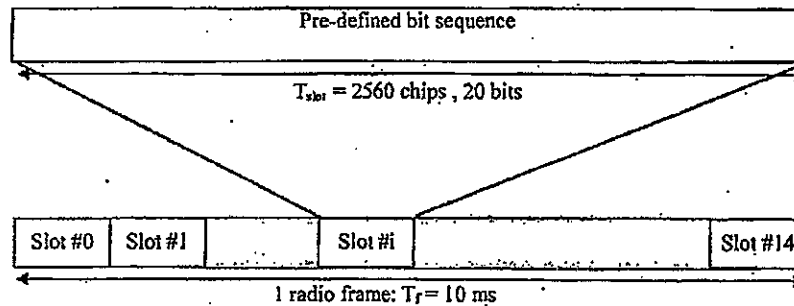


Figure 13: Frame structure for Common Pilot Channel

In case transmit diversity (open or closed loop) is used on any downlink channel in the cell, the CPICH shall be transmitted from both antennas using the same channelization and scrambling code. In this case, the pre-defined bit sequence of the CPICH is different for Antenna 1 and Antenna 2, see figure 14. In case of no transmit diversity, the bit sequence of Antenna 1 in figure 14 is used.

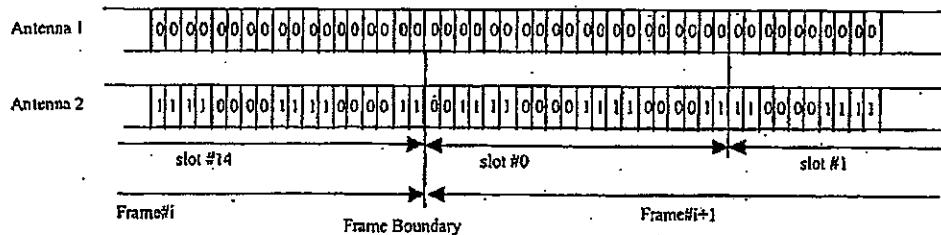


Figure 14: Modulation pattern for Common Pilot Channel

There are two types of Common pilot channels, the Primary and Secondary CPICH. They differ in their use and the limitations placed on their physical features.

5.3.3.1.1 Primary Common Pilot Channel (P-CPICH)

The Primary Common Pilot Channel (P-CPICH) has the following characteristics:

- The same channelization code is always used for the P-CPICH, see [4];
- The P-CPICH is scrambled by the primary scrambling code, see [4];
- There is one and only one P-CPICH per cell;
- The P-CPICH is broadcast over the entire cell.

The Primary CPICH is a phase reference for the following downlink channels: SCH, Primary CGPCH, AICH, PICH, AP-AICH, CD/CA-ICH, CSICH, DL-DPCCH for CPCH and the S-CCPCH. By default, the Primary CPICH is also a phase reference for downlink DPCH and any associated PDSCH. The UE is informed by higher layer signalling if the P-CPICH is not a phase reference for a downlink DPCH and any associated PDSCH.

The Primary CPICH is always a phase reference for a downlink physical channel using closed loop TX diversity.

5.3.3.1.2 Secondary Common Pilot Channel (S-CPICH)

A Secondary Common Pilot Channel (S-CPICH) has the following characteristics:

- An arbitrary channelization code of SF=256 is used for the S-CPICH, see [4];
- A S-CPICH is scrambled by either the primary or a secondary scrambling code, see [4];
- There may be zero, one, or several S-CPICH per cell;
- A S-CPICH may be transmitted over the entire cell or only over a part of the cell;

A Secondary CPICH may be a phase reference for a downlink DPCH. If this is the case, the UE is informed about this by higher-layer signalling.

The Secondary CPICH can be a phase reference for a downlink physical channel using open loop TX diversity, instead of the Primary CPICH being a phase reference.

Note that it is possible that neither the P-CPICH nor any S-CPICH is a phase reference for a downlink DPCH.

5.3.3.2 Downlink phase reference

Table 17 summarizes the possible phase references usable on different downlink physical channel types.

Table 17: Application of phase references on downlink physical channel types
"X" – can be applied, "-" – not applied

Physical channel type	Primary-CPICH	Secondary-CPICH	Dedicated pilot
P-CCPCH	X	-	-
SCH	X	-	-
S-CCPCH	X	-	-
DPCH	X	X	X
PICH	X	-	-
PDSCH*	X	X	X
AICH	X	-	-
CSICH	X	-	-
DL-DPCCH for CPCH	X	-	-

Note *: the same phase reference as with the associated DPCH shall be used.

Furthermore, during a PDSCH frame, and within the slot prior to that PDSCH frame, the phase reference on the associated DPCH shall not change.

5.3.3.3 Primary Common Control Physical Channel (P-CCPCH)

The Primary CCPCH is a fixed rate (30 kbps, SF=256) downlink physical channels used to carry the BCH transport channel.

Figure 15 shows the frame structure of the Primary CCPCH. The frame structure differs from the downlink DPCH in that no TPC commands, no TFCI and no pilot bits are transmitted. The Primary CCPCH is not transmitted during the first 256 chips of each slot. Instead, Primary SCH and Secondary SCH are transmitted during this period (see subclause 5.3.3.5).

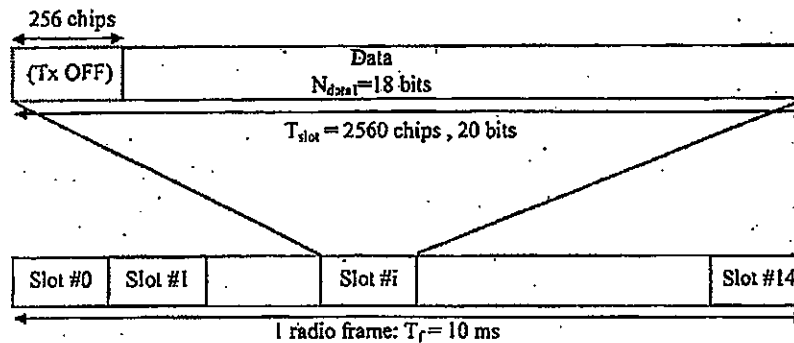


Figure 15: Frame structure for Primary Common Control Physical Channel

5.3.3.3.1 Primary CCPCH structure with STTD encoding

In case the diversity antenna is present in UTRAN and the P-CCPCH is to be transmitted using open loop transmit diversity, the data bits of the P-CCPCH are STTD encoded as given in subclause 5.3.1.1.1. The last two data bits in even numbered slots are STTD encoded together with the first two data bits in the following slot, except for slot #14 where the two last data bits are not STTD encoded and instead transmitted with equal power from both the antennas, see figure-16. Higher layers signal whether STTD encoding is used for the P-CCPCH or not. In addition the presence/absence of STTD encoding on P-CCPCH is indicated by modulating the SCH, see 5.3.3.4. During power on and hand over between cells the UE can determine the presence of STTD encoding on the P-CCPCH, by either receiving the higher layer message, by demodulating the SCH channel, or by a combination of the above two schemes.

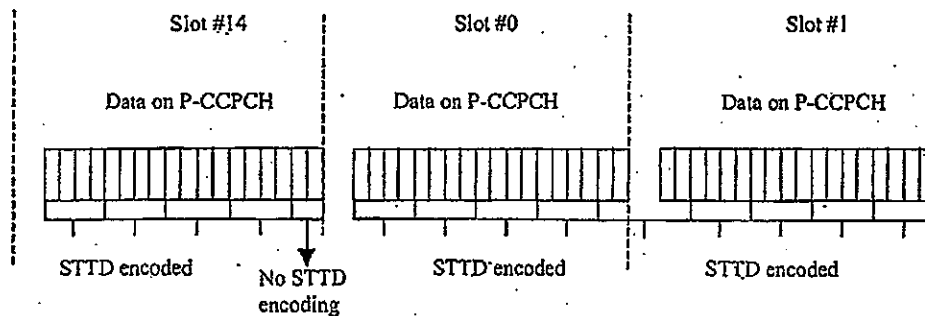


Figure 16: STTD encoding for the data bits of the P-CCPCH

5.3.3.4 Secondary Common Control Physical Channel (S-CCPCH)

The Secondary CCPCH is used to carry the FACH and PCH. There are two types of Secondary CCPCH: those that include TFCI and those that do not include TFCI. It is the UTRAN that determines if a TFCI should be transmitted, hence making it mandatory for all UEs to support the use of TFCI. The set of possible rates for the Secondary CCPCH

is the same as for the downlink DPCH, see subclause 5.3.2. The frame structure of the Secondary CCPCH is shown in figure 17.

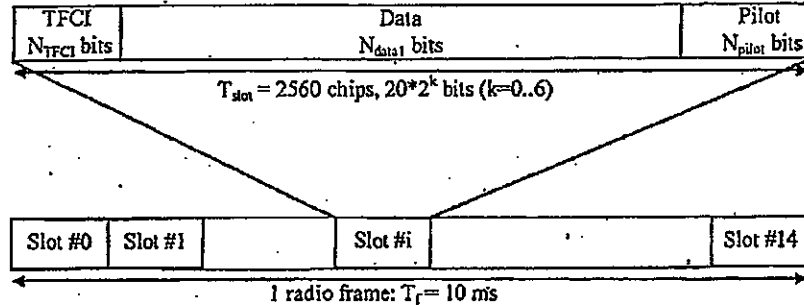


Figure 17: Frame structure for Secondary Common Control Physical Channel

The parameter k in figure 17 determines the total number of bits per downlink Secondary CCPCH slot. It is related to the spreading factor SF of the physical channel as $SF = 256/2^k$. The spreading factor range is from 256 down to 4.

The values for the number of bits per field are given in table 18. The channel bit and symbol rates given in table 18 are the rates immediately before spreading. The slot formats with pilot bits are not supported in this release. The pilot patterns are given in table 19.

The FACH and PCH can be mapped to the same or to separate Secondary CCPCHs. If FACH and PCH are mapped to the same Secondary CCPCH, they can be mapped to the same frame. The main difference between a CCPCH and a downlink dedicated physical channel is that a CCPCH is not inner-loop power controlled. The main difference between the Primary and Secondary CCPCH is that the transport channel mapped to the Primary CCPCH (BCH) can only have a fixed predefined transport format combination, while the Secondary CCPCH support multiple transport format combinations using TFCI.

Table 18: Secondary CCPCH fields

Slot Format #1	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/ Frame	Bits/ Slot	N _{data}	N _{pilot}	N _{TFCI}
0	30	15	256	300	20	20	0	0
1	30	15	256	300	20	12	8	0
2	30	15	256	300	20	18	0	2
3	30	15	256	300	20	10	8	2
4	60	30	128	600	40	40	0	0
5	60	30	128	600	40	32	8	0
6	60	30	128	600	40	38	0	2
7	60	30	128	600	40	30	8	2
8	120	60	64	1200	80	72	0	8*
9	120	60	64	1200	80	64	8	8*
10	240	120	32	2400	160	152	0	8*
11	240	120	32	2400	160	144	8	8*
12	480	240	16	4800	320	312	0	8*
13	480	240	16	4800	320	296	16	8*
14	960	480	8	9600	640	632	0	8*
15	960	480	8	9600	640	616	16	8*
16	1920	960	4	19200	1280	1272	0	8*
17	1920	960	4	19200	1280	1256	16	8*

* If TFCI bits are not used, then DTX shall be used in TFCI field.

The pilot symbol pattern described in table 19 is not supported in this release. The shadowed part can be used as frame synchronization words. (The symbol pattern of pilot symbols other than the frame synchronization word shall be "11"). In table 19, the transmission order is from left to right. (Each two-bit pair represents an I/Q pair of QPSK modulation.)

Table 19: Pilot Symbol Pattern

Symbol #	N _{pilot} = 8				N _{pilot} = 16							
	0	1	2	3	0	1	2	3	4	5	6	7
Slot #0	11	11	11	10	11	11	11	10	11	11	11	10
1	11	00	11	10	11	00	11	10	11	11	11	00
2	11	01	11	01	11	01	11	01	11	10	11	00
3	11	00	11	00	11	00	11	00	11	01	11	10
4	11	10	11	01	11	10	11	01	11	11	11	11
5	11	11	11	10	11	11	11	10	11	01	11	01
6	11	11	11	00	11	11	11	00	11	10	11	11
7	11	10	11	00	11	10	11	00	11	10	11	00
8	11	01	11	10	11	01	11	10	11	00	11	11
9	11	11	11	11	11	11	11	11	11	00	11	11
10	11	01	11	01	11	01	11	01	11	11	11	10
11	11	10	11	11	11	10	11	11	11	00	11	10
12	11	10	11	00	11	10	11	00	11	01	11	01
13	11	00	11	11	11	00	11	11	11	00	11	00
14	11	00	11	11	11	00	11	11	11	10	11	01

For slot formats using TFCI, the TFCI value in each radio frame corresponds to a certain transport format combination of the FACHs and/or PCHs currently in use. This correspondence is (re-)negotiated at each FACH/PCH addition/removal. The mapping of the TFCI bits onto slots is described in [3].

5.3.3.4.1 Secondary CCPCH structure with STTD encoding

In case the diversity antenna is present in UTRAN and the S-CCPCH is to be transmitted using open loop transmit diversity, the data and TFCI bits of the S-CCPCH are STTD encoded as given in subclause 5.3.1.1.1. The pilot symbol pattern for antenna 2 for the S-CCPCH given in table 20 is not supported in this release.

Table 20: Pilot symbol pattern for antenna 2 when STTD encoding is used on the S-CCPCH

Symbol #	N _{pilot} = 8				N _{pilot} = 16							
	0	1	2	3	0	1	2	3	4	5	6	7
Slot #0	11	00	00	10	11	00	00	10	11	00	00	10
1	11	00	00	01	11	00	00	01	11	10	00	10
2	11	11	00	00	11	11	00	00	11	10	00	11
3	11	10	00	01	11	10	00	01	11	00	00	00
4	11	11	00	11	11	11	00	11	11	01	00	10
5	11	00	00	10	11	00	00	10	11	11	00	00
6	11	10	00	10	11	10	00	10	11	01	00	11
7	11	10	00	11	11	10	00	11	11	10	00	11
8	11	00	00	00	11	00	00	00	11	01	00	01
9	11	01	00	10	11	01	00	10	11	01	00	01
10	11	11	00	00	11	11	00	00	11	00	00	10
11	11	01	00	11	11	01	00	11	11	00	00	00
12	11	10	00	11	11	10	00	11	11	00	00	00
13	11	01	00	11	11	01	00	11	11	00	00	00
14	11	00	00	11	11	00	00	11	11	00	00	00

5.3.3.5 Synchronisation Channel (SCH)

The Synchronisation Channel (SCH) is a downlink signal used for cell search. The SCH consists of two sub channels, the Primary and Secondary SCH. The 10 ms radio frames of the Primary and Secondary SCH are divided into 15 slots, each of length 2560 chips. Figure 18 illustrates the structure of the SCH radio frame.

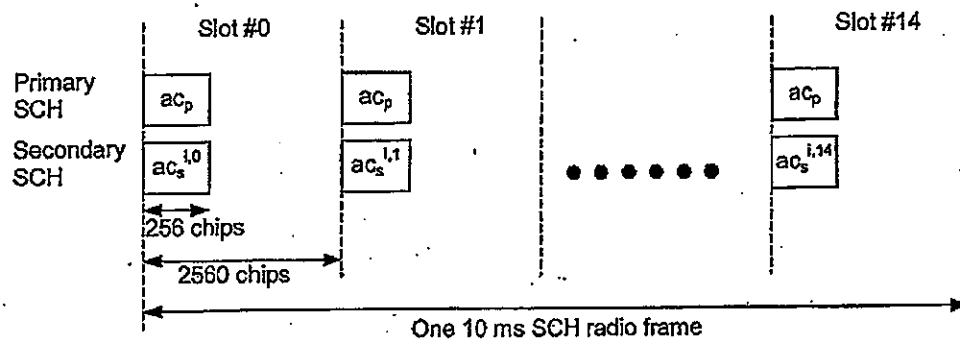


Figure 18: Structure of Synchronisation Channel (SCH)

The Primary SCH consists of a modulated code of length 256 chips, the Primary Synchronisation Code (PSC) denoted c_p in figure 18, transmitted once every slot. The PSC is the same for every cell in the system.

The Secondary SCH consists of repeatedly transmitting a length 15 sequence of modulated codes of length 256 chips, the Secondary Synchronisation Codes (SSC), transmitted in parallel with the Primary SCH. The SSC is denoted $c_s^{i,k}$ in figure 18, where $i = 0, 1, \dots, 63$ is the number of the scrambling code group, and $k = 0, 1, \dots, 14$ is the slot number. Each SSC is chosen from a set of 16 different codes of length 256. This sequence on the Secondary SCH indicates which of the code groups the cell's downlink scrambling code belongs to.

The primary and secondary synchronization codes are modulated by the symbol a shown in figure 18, which indicates the presence/absence of STTD encoding on the P-CCPCH and is given by the following table:

P-CCPCH STTD encoded	$a = +1$
P-CCPCH not STTD encoded	$a = -1$

5.3.3.5.1 SCH transmitted by TSTD

Figure 19 illustrates the structure of the SCH transmitted by the TSTD scheme. In even numbered slots both PSC and SSC are transmitted on antenna 1, and in odd numbered slots both PSC and SSC are transmitted on antenna 2.

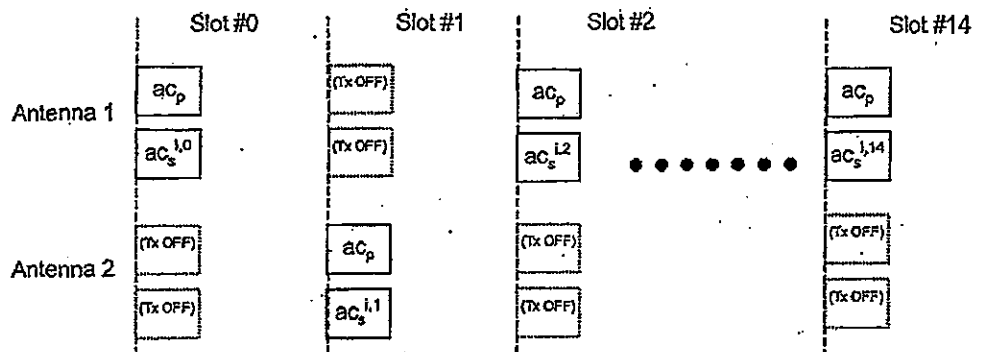


Figure 19: Structure of SCH transmitted by TSTD scheme

5.3.3.6 Physical Downlink Shared Channel (PDSCH)

The Physical Downlink Shared Channel (PDSCH) is used to carry the Downlink Shared Channel (DSCH).

A PDSCH corresponds to a channelisation code below or at a PDSCH root channelisation code. A PDSCH is allocated on a radio frame basis to a single UE. Within one radio frame, UTRAN may allocate different PDSCHs under the same PDSCH root channelisation code to different UEs based on code multiplexing. Within the same radio frame, multiple

parallel PDSCHs, with the same spreading factor, may be allocated to a single UE. This is a special case of multicode transmission. All the PDSCHs are operated with radio frame synchronisation.

The notion of PDSCH root channelisation code is defined in [4].

PDSCHs allocated to the same UE on different radio frames may have different spreading factors.

The frame and slot structure of the PDSCH are shown on figure 20.

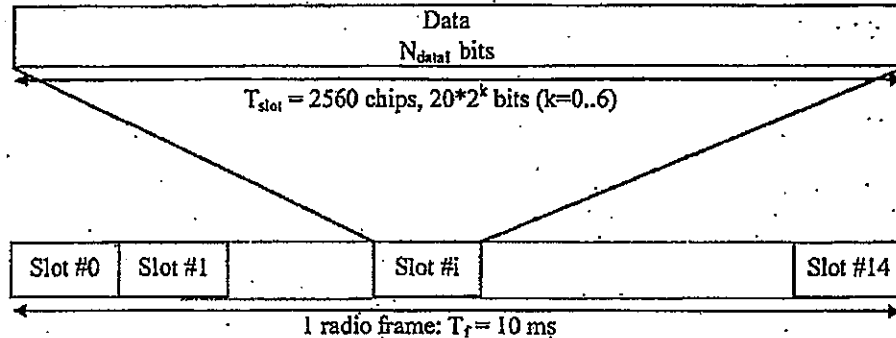


Figure 20: Frame structure for the PDSCH

For each radio frame, each PDSCH is associated with one downlink DPCH. The PDSCH and associated DPCH do not necessarily have the same spreading factors and are not necessarily frame aligned.

All relevant Layer 1 control information is transmitted on the DPCH part of the associated DPCH, i.e. the PDSCH does not carry Layer 1 information. To indicate for UE that there is data to decode on the DSCH, the TFCI field of the associated DPCH shall be used.

The TFCI informs the UE of the instantaneous transport format parameters related to the PDSCH as well as the channelisation code of the PDSCH.

The channel bit rates and symbol rates for PDSCH are given in table 21.

For PDSCH the allowed spreading factors may vary from 256 to 4.

Table 21: PDSCH fields

Slot format #i	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/Frame	Bits/Slot	N _{data}
0	30	15	256	300	20	20
1	60	30	128	600	40	40
2	120	60	64	1200	80	80
3	240	120	32	2400	160	160
4	480	240	16	4800	320	320
5	960	480	8	9600	640	640
6	1920	960	4	19200	1280	1280

When open loop transmit diversity is employed for the PDSCH, STTD encoding is used on the data bits as described in subclause 5.3.1.1.1.

When closed loop transmit diversity is employed on the associated DPCH, it shall be used also on the PDSCH as described in [5].

5.3.3.7 Acquisition Indicator Channel (AICH)

The Acquisition Indicator channel (AICH) is a fixed rate (SF=256) physical channel used to carry Acquisition Indicators (AI). Acquisition Indicator AI_s corresponds to signature s on the PRACH.

Figure 21 illustrates the structure of the AICH. The AICH consists of a repeated sequence of 15 consecutive *access slots* (AS), each of length 5120 chips. Each access slot consists of two parts, an *Acquisition-Indicator* (AI) part consisting of 32 real-valued symbols a_0, \dots, a_{31} and a part of duration 1024 chips with no transmission that is not formally part of the AICH. The part of the slot with no transmission is reserved for possible use by CSICH or possible future use by other physical channels.

The spreading factor (SF) used for channelisation of the AICH is 256.

The phase reference for the AICH is the Primary CPICH.

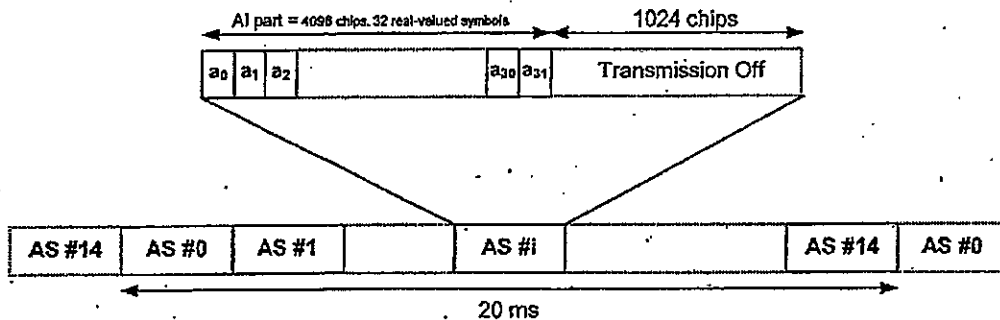


Figure 21: Structure of Acquisition Indicator Channel (AICH)

The real-valued symbols a_0, a_1, \dots, a_{31} in figure 21 are given by

$$a_j = \sum_{s=0}^{15} AI_s b_{s,j}$$

where AI_s , taking the values +1, -1, and 0, is the acquisition indicator corresponding to signature s and the sequence $b_{s,0}, \dots, b_{s,31}$ is given by table 22. If the signature s is not a member of the set of available signatures for all the Access Service Class (ASC) for the corresponding PRACH (cf [5]), then AI_s shall be set to 0.

The use of acquisition indicators is described in [5]. If an Acquisition Indicator is set to +1, it represents a positive acknowledgement. If an Acquisition Indicator is set to -1, it represents a negative acknowledgement.

The real-valued symbols, a_j , are spread and modulated in the same fashion as bits when represented in $\{+1, -1\}$ form.

In case STTD-based open-loop transmit diversity is applied to AICH, STTD encoding according to subclause 5.3.1.1.1 is applied to each sequence $b_{s,0}, b_{s,1}, \dots, b_{s,31}$ separately before the sequences are combined into AICH symbols a_0, \dots, a_{31} .

Table 22: AICH signature patterns

s	$b_{s,0}, b_{s,1}, \dots, b_{s,31}$																																															
0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1								
2	1	1	1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1	-1	-1				
3	1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1	-1	-1						
4	1	1	1	1	1	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
5	1	1	-1	-1	1	1	-1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1			
6	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
7	1	1	-1	-1	-1	-1	1	1	-1	-1	1	1	1	1	-1	-1	1	1	-1	-1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
9	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1				
10	1	1	1	1	-1	-1	-1	-1	1	1	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
11	1	1	-1	-1	-1	-1	1	1	1	-1	-1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1			
12	1	1	1	1	1	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1			
13	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1
14	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
15	1	1	-1	-1	-1	-1	1	1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			

5.3.3.8 CPCH Access Preamble Acquisition Indicator Channel (AP-AICH)

The Access Preamble Acquisition Indicator channel (AP-AICH) is a fixed rate (SF=256) physical channel used to carry AP acquisition indicators (API) of CPCH. AP acquisition indicator API_s corresponds to AP signature s transmitted by UE.

AP-AICH and AICH may use the same or different channelisation codes. The phase reference for the AP-AICH is the Primary CPICH. Figure 22 illustrates the structure of AP-AICH. The AP-AICH has a part of duration 4096 chips where the AP acquisition indicator (API) is transmitted, followed by a part of duration 1024 chips with no transmission that is not formally part of the AP-AICH. The part of the slot with no transmission is reserved for possible use by CSICH or possible future use by other physical channels.

The spreading factor (SF) used for channelisation of the AP-AICH is 256.

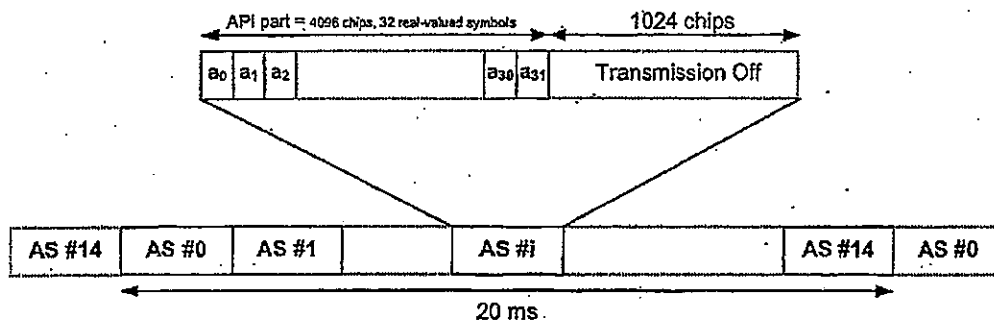


Figure 22: Structure of AP Acquisition Indicator Channel (AP-AICH)

The real-valued symbols a_0, a_1, \dots, a_{31} in figure 22 are given by

$$a_j = \sum_{s=0}^{15} API_s \times b_{s,j}$$

where API_s , taking the values +1, -1, and 0, is the AP acquisition indicator corresponding to Access Preamble signature s transmitted by UE and the sequence $b_{s,0}, \dots, b_{s,31}$ is given in Table 22. If the signature s is not a member of the set of UL Access Preamble signatures for the corresponding PCPCH (cf [5]) then API_s shall be set to 0.

The use of acquisition indicators is described in [5]. If an AP acquisition indicator is set to +1, it represents a positive acknowledgement. If an AP acquisition indicator is set to -1, it represents a negative acknowledgement.

The real-valued symbols, a_j , are spread and modulated in the same fashion as bits when represented in $\{+1, -1\}$ form.

In case STTD-based open-loop transmit diversity is applied to AP-AICH, STTD encoding according to subclause 5.3.1.1.1 is applied to each sequence $b_{s,0}, b_{s,1}, \dots, b_{s,31}$ separately before the sequences are combined into AP-AICH symbols a_0, \dots, a_{31} .

5.3.3.9 CPCH Collision Detection/Channel Assignment Indicator Channel (CD/CA-ICH)

The Collision Detection Channel Assignment Indicator channel (CD/CA-ICH) is a fixed rate (SF=256) physical channel used to carry CD Indicator (CDI) only if the CA is not active, or CD Indicator/CA Indicator (CDI/CAI) at the same time if the CA is active. The structure of CD/CA-ICH is shown in figure 23. CD/CA-ICH and AP-AICH may use the same or different channelisation codes.

The CD/CA-ICH has a part of duration of 4096 chips where the CDI/CAI is transmitted, followed by a part of duration 1024 chips with no transmission that is not formally part of the CD/CA-ICH. The part of the slot with no transmission is reserved for possible use by CSICH or possible future use by other physical channels.

The spreading factor (SF) used for channelisation of the CD/CA-ICH is 256.

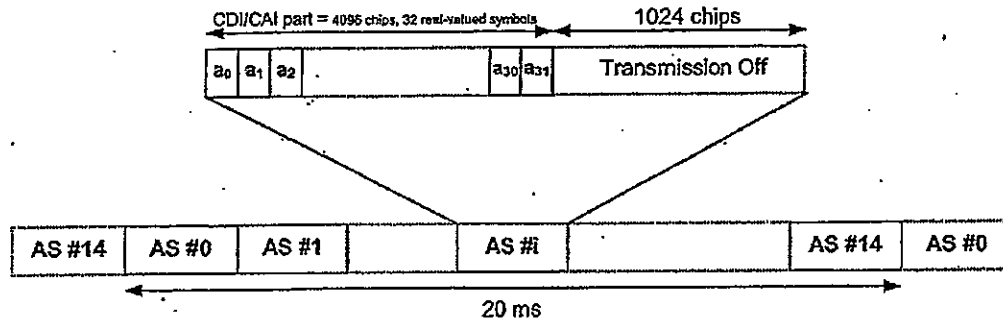


Figure 23: Structure of CD/CA Indicator Channel (CD/CA-ICH)

In case STTD-based open-loop transmit diversity is applied to CD/CA-ICH, STTD encoding according to subclause 5.3.1.1.1 is applied to each sequence $b_{s,0}, b_{s,1}, \dots, b_{s,31}$ separately before the sequences are combined into CD/CA-ICH symbols a_0, \dots, a_{31} .

In case CA is not active, the real-valued symbols a_0, a_1, \dots, a_{31} in figure 23 are given by

$$a_j = \sum_{s=0}^{15} \text{CDI}_s \times b_{s,j}$$

where CDI_s , taking the values $+1$, and 0 , is the CD indicator corresponding to CD preamble signature s transmitted by UE and the sequence $b_{s,0}, \dots, b_{s,31}$ is given in table 22. If the signature s is not a member of the set of CD Preamble signatures for the corresponding PCPCH (cf [5]), then CDI_s shall be set to 0 .

The real-valued symbols, a_j , are spread and modulated in the same fashion as bits when represented in $\{+1, -1\}$ form.

In case CA is active, the real-valued symbols a_0, a_1, \dots, a_{31} in figure 23 are given by

$$a_j = \sum_{i=0}^{15} \text{CDI}_i \times b_{s_i,j} + \sum_{k=0}^{15} \text{CAI}_k \times b_{s_k,j}$$

where the subscript s_i, s_k depend on the indexes i, k according to table 23, respectively, and indicate the signature number s in table 22. The sequence $b_{s,0}, \dots, b_{s,31}$ is given in table 22. CDI_i , taking the values $+1/0$ or $-1/0$, is the CD indicator corresponding to the CD preamble i transmitted by the UE, and CAI_k , taking the values $+1/0$ or $-1/0$, is the CA indicator corresponding to the assigned channel index k as given in table 23. If the signature s_i is not a member of the set of CD Preamble signatures for the corresponding PCPCH (cf [5]), then CDI_i shall be set to 0 . Similarly, if the

signature s_k is not a member of the set of CD Preamble signatures for the corresponding PCPCH (cf [5]), then CDI_k shall be set to 0.

Table 23. Generation of CDI_k/CAI_k

UE transmitted CD Preamble l	CDI_k	signature s_l	Channel Assignment Index k	CAI_k	signature s_k
0	+1/0	1	0	+1/0	0
1	-1/0		1	-1/0	
2	+1/0	3	2	+1/0	8
3	-1/0		3	-1/0	
4	+1/0	5	4	+1/0	4
5	-1/0		5	-1/0	
6	+1/0	7	6	+1/0	12
7	-1/0		7	-1/0	
8	+1/0	9	8	+1/0	2
9	-1/0		9	-1/0	
10	+1/0	11	10	+1/0	10
11	-1/0		11	-1/0	
12	+1/0	13	12	+1/0	6
13	-1/0		13	-1/0	
14	+1/0	15	14	+1/0	14
15	-1/0		15	-1/0	

5.3.3.10 Paging Indicator Channel (PICH)

The Paging Indicator Channel (PICH) is a fixed rate (SF=256) physical channel used to carry the paging indicators. The PICH is always associated with an S-CCPCH to which a PCH transport channel is mapped.

Figure 24 illustrates the frame structure of the PICH. One PICH radio frame of length 10 ms consists of 300 bits (b_0, b_1, \dots, b_{299}). Of these, 288 bits (b_0, b_1, \dots, b_{287}) are used to carry paging indicators. The remaining 12 bits are not formally part of the PICH and shall not be transmitted (DTX). The part of the frame with no transmission is reserved for possible future use.

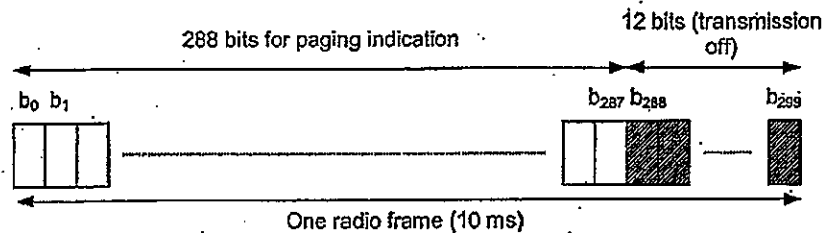


Figure 24: Structure of Paging Indicator Channel (PICH)

In each PICH frame, N_p paging indicators $\{P_0, \dots, P_{N_p-1}\}$ are transmitted, where $N_p=18, 36, 72$, or 144 .

The PI calculated by higher layers for use for a certain UE, is associated to the paging indicator P_q , where q is computed as a function of the PI computed by higher layers, the SFN of the P-CCPCH radio frame during which the start of the PICH radio frame occurs, and the number of paging indicators per frame (N_p):

$$q = \left(PI + \left[\left((18 \times (SFN + \lfloor SFN/8 \rfloor + \lfloor SFN/64 \rfloor + \lfloor SFN/512 \rfloor)) \bmod 144 \right) \times \frac{N_p}{144} \right] \right) \bmod N_p$$

Further, the PI calculated by higher layers is associated with the value of the paging indicator P_q . If a paging indicator in a certain frame is set to "1" it is an indication that UEs associated with this paging indicator and PI should read the corresponding frame of the associated S-CCPCH.

The PI bitmap in the PCH data frames over I_{ub} contains indication values for all higher layer PI values possible. Each bit in the bitmap indicates if the paging indicator associated with that particular PI shall be set to 0 or 1. Hence, the calculation in the formula above is to be performed in Node B to make the association between PI and P_q .

The mapping from $\{P_0, \dots, P_{N_p-1}\}$ to the PICH bits $\{b_0, \dots, b_{287}\}$ are according to table 24.

Table 24: Mapping of paging indicators P_q to PICH bits

Number of paging indicators per frame (N_p)	$P_q = 1$	$P_q = 0$
$N_p=18$	$\{b_{18q}, \dots, b_{18q+15}\} = \{1, 1, \dots, 1\}$	$\{b_{18q}, \dots, b_{18q+15}\} = \{0, 0, \dots, 0\}$
$N_p=36$	$\{b_{36q}, \dots, b_{36q+7}\} = \{1, 1, \dots, 1\}$	$\{b_{36q}, \dots, b_{36q+7}\} = \{0, 0, \dots, 0\}$
$N_p=72$	$\{b_{72q}, \dots, b_{72q+3}\} = \{1, 1, \dots, 1\}$	$\{b_{72q}, \dots, b_{72q+3}\} = \{0, 0, \dots, 0\}$
$N_p=144$	$\{b_{144q}, b_{144q+1}\} = \{1, 1\}$	$\{b_{144q}, b_{144q+1}\} = \{0, 0\}$

When transmit diversity is employed for the PICH, STTD encoding is used on the PICH bits as described in subclause 5.3.1.1.1.

5.3.3.11 CPCH Status Indicator Channel (CSICH)

The CPCH Status Indicator Channel (CSICH) is a fixed rate, (SF=256) physical channel used to carry CPCH status information.

A CSICH is always associated with a physical channel used for transmission of CPCH AP-AICH and uses the same channelization and scrambling codes. Figure 25 illustrates the frame structure of the CSICH. The CSICH frame consists of 15 consecutive access slots (AS) each of length 40 bits. Each access slot consists of two parts, a part of duration 4096 chips with no transmission that is not formally part of the CSICH, and a Status Indicator (SI) part consisting of 8 bits b_{8i}, \dots, b_{8i+7} , where i is the access slot number. The part of the slot with no transmission is reserved for use by AICH, AP-AICH or CD/CA-ICH. The modulation used by the CSICH is the same as for the PICH. The phase reference for the CSICH is the Primary CPICH.

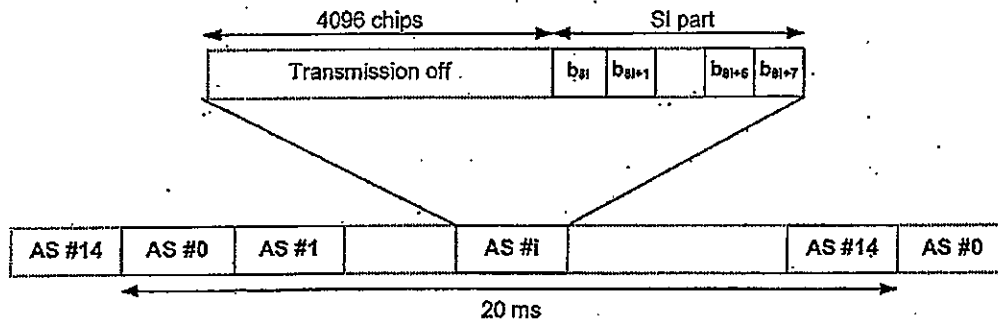


Figure 25: Structure of CPCH Status Indicator Channel (CSICH)

N Status Indicators $\{SI_0, \dots, SI_{N-1}\}$ shall be transmitted in each CSICH frame. The mapping from $\{SI_0, \dots, SI_{N-1}\}$ to the CSICH bits $\{b_0, \dots, b_{119}\}$ is according to table 25. The Status Indicators shall be transmitted in all the access slots of the CSICH frame, even if some signatures and/or access slots are shared between CPCH and RACH.

Table 25: Mapping of Status Indicators (SI) to CSICH bits

Number of SI per frame (N)	$SI_n = 1$	$SI_n = 0$
N=1	$\{b_0, \dots, b_{119}\} = \{1, 1, \dots, 1\}$	$\{b_0, \dots, b_{119}\} = \{0, 0, \dots, 0\}$
N=3	$\{b_{40n}, \dots, b_{40n+39}\} = \{1, 1, \dots, 1\}$	$\{b_{40n}, \dots, b_{40n+39}\} = \{0, 0, \dots, 0\}$
N=5	$\{b_{24n}, \dots, b_{24n+23}\} = \{1, 1, \dots, 1\}$	$\{b_{24n}, \dots, b_{24n+23}\} = \{0, 0, \dots, 0\}$
N=15	$\{b_{8n}, \dots, b_{8n+7}\} = \{1, 1, \dots, 1\}$	$\{b_{8n}, \dots, b_{8n+7}\} = \{0, 0, \dots, 0\}$
N=30	$\{b_{4n}, \dots, b_{4n+3}\} = \{1, 1, 1, 1\}$	$\{b_{4n}, \dots, b_{4n+3}\} = \{0, 0, 0, 0\}$
N=60	$\{b_{2n}, b_{2n+1}\} = \{1, 1\}$	$\{b_{2n}, b_{2n+1}\} = \{0, 0\}$

When transmit diversity is employed for the CSICH, STTD encoding is used on the CSICH bits as described in subclause 5.3.1.1.1.

The CPCH Status Indicator mode (CSICH mode) defines the structure of the information carried on the CSICH. At the UTRAN the value of the CPCH Status Indicator mode is set by higher layers. There are two CSICH modes depending on whether Channel Assignment is active or not. The CSICH mode defines the number of status indicators per frame and the content of each status indicator. Layer 1 transmits the CSICH information according to the CSICH mode and the structures defined in the following paragraphs.

5.3.3.11.1 CSICH Information Structure when Channel Assignment is not active

In this mode, CPCH Status Indication conveys the PCPCH Channel Availability value which is a 1 to 16 bit value which indicates the availability of each of the 1 to 16 defined PCPCHs in the CPCH set. PCPCHs are numbered from PCPCH0 through PCPCH15. There is one bit of the PCPCH Resource Availability (PRA) value for each defined PCPCH channel. If there are 2 PCPCHs defined in the CPCH set, then there are 2 bits in the PRA value. And likewise for other numbers of defined PCPCH channels up to 16 maximum CPCH channels per set when Channel Assignment is not active.

The number of SIs (Status Indicators) per frame is a function of the number of defined PCPCH channels.

Number of defined PCPCHs(=K)	Number of SIs per frame(=N)
1, 2, 3	3
4, 5	5
6, 7, 8, 9, 10, 11, 12, 13, 14, 15	15
16	30

The value of the SI shall indicate the PRA value for one of the defined PCPCHs, where $PRA(n)=1$ indicates that the PCPCH is available, and $PRA(n)=0$ indicates that the PCPCH is not available. $SI(0)$ shall indicate $PRA(0)$ for PCPCH0, $SI(1)$ shall indicate $PRA(1)$ for PCPCH1, etc., for each defined PCPCH. When the number of SIs per frame exceeds the number of defined PCPCHs (K), the SIs which exceed K shall be set to repeat the PRA values for the defined PCPCHs. In general,

$$SI(n) = PRA(n \bmod (K)),$$

where $PRA(i)$ is availability of PCPCHi,

and n ranges from 0 to N-1.

5.3.3.11.2 PCPCH Availability when Channel Assignment is active

In this mode, CPCH Status Indication conveys two pieces of information. One is the Minimum Available Spreading Factor (MASF) value and the other is the PCPCH Resource Availability (PRA) value.

- MASF is a 3 bit number with bits MASF(0) through MASF(2) where MASF(0) is the MSB of the MASF value and MASF(2) is the LSB of the MASF value.

The following table defines MASF(0), MASF(1) and MASF(2) values to convey the MASF. All spreading factors greater than MASF are available

Minimum Available Spreading Factor (MASF)	MASF(0)	MASF(1)	MASF(2)
N/A (No available CPCH resources)	0	0	0
256	0	0	1
128	0	1	0
64	0	1	1
32	1	0	0
16	1	0	1
08	1	1	0
04	1	1	1

The number of SIs (Status Indicators) per frame, N is a function of the number of defined PCPCH channels, K .

Number of defined PCPCHs(K)	Number of SIs per frame(N)
1, 2,	5
3, 4, 5, 6, 7, 8, 9, 10, 11, 12	15
13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27	30
28, ..., 57	60

$PRA(n)=1$ indicates that the PCPCH $_n$ is available, and $PRA(n)=0$ indicates that the PCPCH $_n$ is not available. PRA value for each PCPCH channel defined in a CPCH set shall be assigned to one SI (Status Indicator), and 3-bit MASF value shall be assigned to SIs as shown in Figure 26.

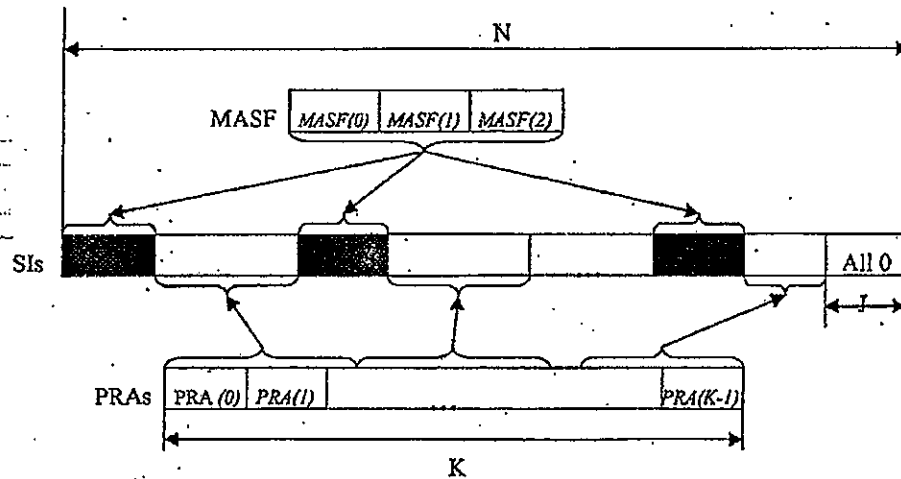


Figure 26: Mapping of MASF and PRAs to SIs in CSICH

The number of repetition that 3-bit MASF values shall be repeated is

$$T = \lfloor (N - K) / 3 \rfloor$$

where $\lfloor x \rfloor$ is largest integer less than or equal to x . Each MASF value i , $MASF(n)$, shall be mapped to SI as follows.

$$SI_{l(i+4)+i} = MASF(i), \quad 0 \leq i \leq 2 \quad l = 0, 1, \dots, s-1$$

$$SI_{s+l(i+3)+i} = MASF(i), \quad 0 \leq i \leq 2 \quad l = s, s+1, \dots, T-1$$

where

$$l = \lfloor K / T \rfloor$$

and

$$s = K - t \cdot T$$

Each PRA value bit, $PRA(n)$, shall be mapped to SI as follows.

$$SI_{l(t+4)+j+3} = PRA(l+1 \cdot t + j), \quad 0 \leq j \leq t \quad l = 0, 1, \dots, s-1$$

$$SI_{s+l(t+3)+j+3} = PRA(s+1 \cdot t + j), \quad 0 \leq j \leq t-1 \quad l = s, s+1, \dots, T-1$$

The remaining

$$J = N - (3T + K)$$

SIs shall be set to 0.

6 Mapping and association of physical channels

6.1 Mapping of transport channels onto physical channels

Figure 27 summarises the mapping of transport channels onto physical channels.

<u>Transport Channels</u>	<u>Physical Channels</u>
DCH	Dedicated Physical Data Channel (DPDCH) Dedicated Physical Control Channel (DPCCH)
RACH	Physical Random Access Channel (PRACH)
CPCH	Physical Common Packet Channel (PCPCH) Common Pilot Channel (CPICH)
BCH	Primary Common Control Physical Channel (P-CCPCH)
FACH	Secondary Common Control Physical Channel (S-CCPCH)
PCH	
	Synchronisation Channel (SCH)
DSCH	Physical Downlink Shared Channel (PDSCH) Acquisition Indicator Channel (AICH) Access Preamble Acquisition Indicator Channel (AP-AICH) Paging Indicator Channel (PICH) CPCH Status Indicator Channel (CSICH) Collision-Detection/Channel-Assignment Indicator Channel (CD/CA-ICH)

Figure 27: Transport-channel to physical-channel mapping

The DCHs are coded and multiplexed as described in [3], and the resulting data stream is mapped sequentially (first-in-first-mapped) directly to the physical channel(s). The mapping of BCH and FACH/PCH is equally straightforward,

where the data stream after coding and interleaving is mapped sequentially to the Primary and Secondary CCPCH respectively. Also for the RACH, the coded and interleaved bits are sequentially mapped to the physical channel, in this case the message part of the PRACH.

6.2 Association of physical channels and physical signals

Figure 28 illustrates the association between physical channels and physical signals.

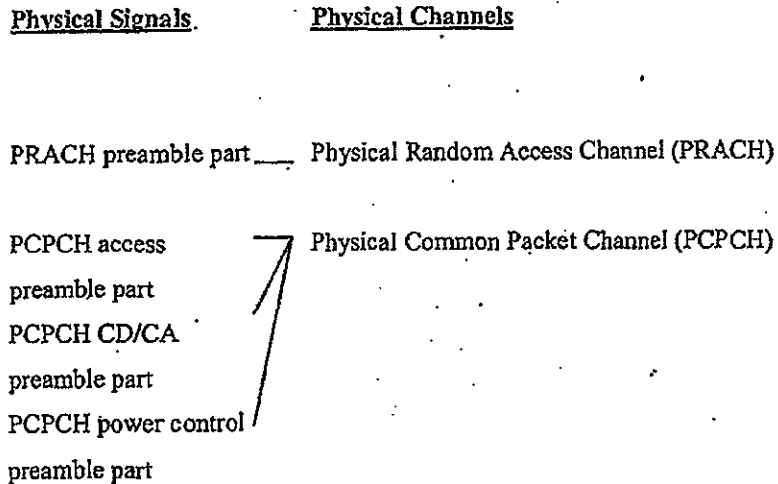


Figure 28: Physical channel and physical signal association

7 Timing relationship between physical channels

7.1 General

The P-CCPCH, on which the cell SFN is transmitted, is used as timing reference for all the physical channels, directly for downlink and indirectly for uplink.

Figure 29 below describes the frame timing of the downlink physical channels. For the AICH the access slot timing is included. Transmission timing for uplink physical channels is given by the received timing of downlink physical channels, as described in the following subclauses.

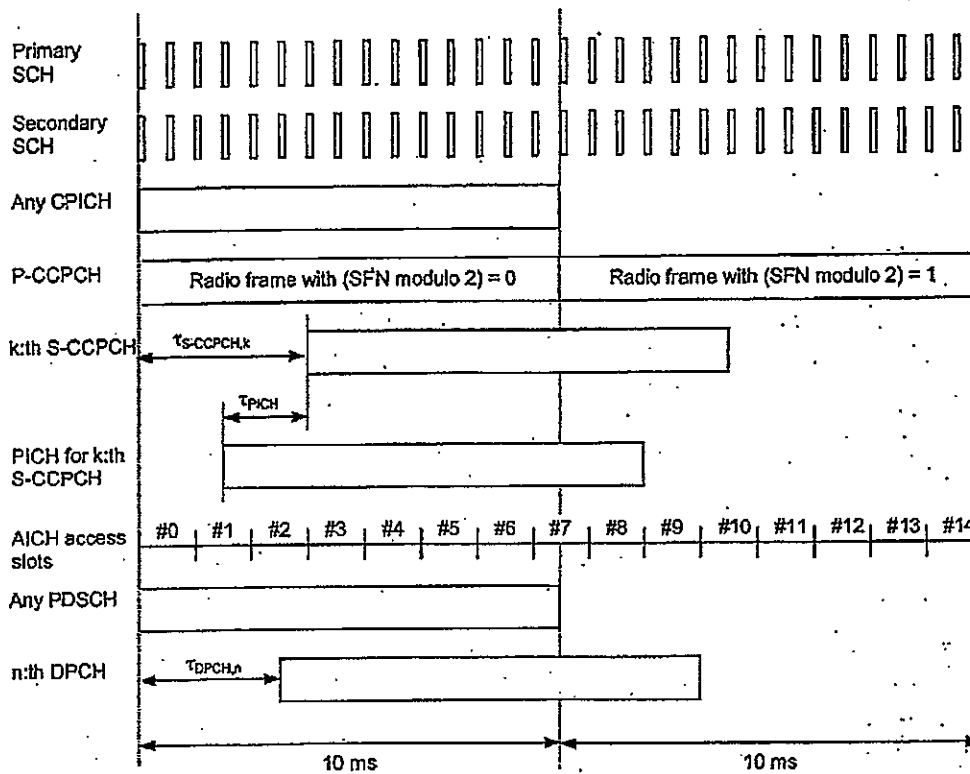


Figure 29: Radio frame timing and access slot timing of downlink physical channels

The following applies:

- SCH (primary and secondary), CPICH (primary and secondary), P-CCPCH, and PDSCH have identical frame timings.
- The S-CCPCH timing may be different for different S-CCPCHs, but the offset from the P-CCPCH frame timing is a multiple of 256 chips, i.e. $\tau_{S-CCPCH,k} = T_k \times 256$ chip, $T_k \in \{0, 1, \dots, 149\}$.
- The PICH timing is $\tau_{PICH} = 7680$ chips prior to its corresponding S-CCPCH frame timing, i.e. the timing of the S-CCPCH carrying the PCH transport channel with the corresponding paging information, see also subclause 7.2.
- AICH access slots #0 starts the same time as P-CCPCH frames with (SFN modulo 2) = 0. The AICH/PRACH and AICH/PCPCH timing is described in subclauses 7.3 and 7.4 respectively.
- The relative timing of associated PDSCH and DPCH is described in subclause 7.5.
- The DPCH timing may be different for different DPCHs, but the offset from the P-CCPCH frame timing is a multiple of 256 chips, i.e. $\tau_{DPCH,n} = T_n \times 256$ chip, $T_n \in \{0, 1, \dots, 149\}$. The DPCH (DPCCH/DPDCH) timing relation with uplink DPCCH/DPDCHs is described in subclause 7.6.

7.2 PICH/S-CCPCH timing relation

Figure 30 illustrates the timing between a PICH frame and its associated single S-CCPCH frame, i.e. the S-CCPCH frame that carries the paging information related to the paging indicators in the PICH frame. A paging indicator set in a PICH frame means that the paging message is transmitted on the PCH in the S-CCPCH frame starting τ_{PICH} chips after the transmitted PICH frame. τ_{PICH} is defined in subclause 7.1.

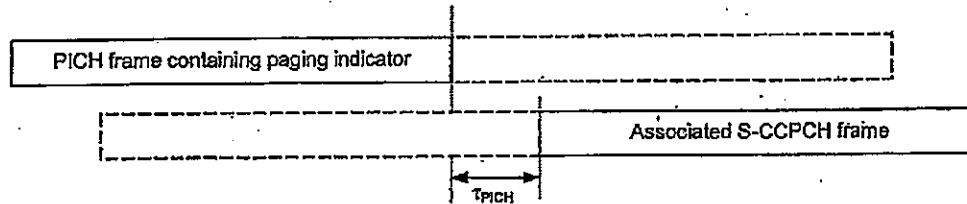


Figure 30: Timing relation between PICH frame and associated S-CCPCH frame

7.3 PRACH/AICH timing relation

The downlink AICH is divided into downlink access slots, each access slot is of length 5120 chips. The downlink access slots are time aligned with the P-CCPCH as described in subclause 7.1.

The uplink PRACH is divided into uplink access slots, each access slot is of length 5120 chips. Uplink access slot number n is transmitted from the UE τ_{p-a} chips prior to the reception of downlink access slot number n , $n = 0, 1, \dots, 14$.

Transmission of downlink acquisition indicators may only start at the beginning of a downlink access slot. Similarly, transmission of uplink RACH preambles and RACH message parts may only start at the beginning of an uplink access slot.

The PRACH/AICH timing relation is shown in figure 31.

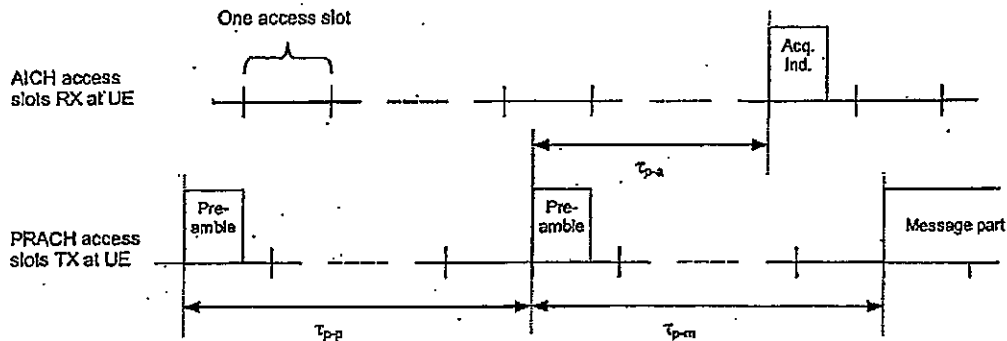


Figure 31: Timing relation between PRACH and AICH as seen at the UE

The preamble-to-preamble distance τ_{p-p} shall be larger than or equal to the minimum preamble-to-preamble distance $\tau_{p-p,min}$, i.e. $\tau_{p-p} \geq \tau_{p-p,min}$.

In addition to $\tau_{p-p, \min}$, the preamble-to-A1 distance τ_{p-a} and preamble-to-message distance τ_{p-m} are defined as follows:

- when AICH_Transmission_Timing is set to 0, then

$$\tau_{p-p, \min} = 15360 \text{ chips (3 access slots)}$$

$$\tau_{p-a} = 7680 \text{ chips}$$

$$\tau_{p-m} = 15360 \text{ chips (3 access slots)}$$

- when AICH_Transmission_Timing is set to 1, then

$$\tau_{p-p, \min} = 20480 \text{ chips (4 access slots)}$$

$$\tau_{p-a} = 12800 \text{ chips}$$

$$\tau_{p-m} = 20480 \text{ chips (4 access slots)}$$

The parameter AICH_Transmission_Timing is signalled by higher layers.

7.4 PCPCH/AICH timing relation

The uplink PCPCH is divided into uplink access slots, each access slot is of length 5120 chips. Uplink access slot number n is transmitted from the UE τ_{p-a1} chips prior to the reception of downlink access slot number n , $n=0, 1, \dots, 14$.

The timing relationship between preambles, AICH, and the message is the same as PRACH/AICH. Note that the collision resolution preambles follow the access preambles in PCPCH/AICH. However, the timing relationships between CD-Preamble and CD/CA-ICH is identical to RACH Preamble and AICH. The timing relationship between CD/CA-ICH and the Power Control Preamble in CPCH is identical to AICH to message in RACH. The T_{epch} timing parameter is identical to the PRACH/AICH transmission timing parameter. When T_{epch} is set to zero or one, the following PCPCH/AICH timing values apply.

Note that a1 corresponds to AP-AICH and a2 corresponds to CD/CA-ICH.

τ_{p-p} = Time to next available access slot, between Access Preambles.

Minimum time = 15360 chips + 5120 chips $\times T_{epch}$

Maximum time = 5120 chips $\times 12 = 61440$ chips

Actual time is time to next slot (which meets minimum time criterion) in allocated access slot subchannel group.

τ_{p-a1} = Time between Access Preamble and AP-AICH has two alternative values: 7680 chips or 12800 chips, depending on T_{epch}

τ_{a1-cdp} = Time between receipt of AP-AICH and transmission of the CD Preamble τ_{a1-cdp} has a minimum value of $\tau_{a1-cdp, \min} = 7680$ chips.

τ_{p-cdp} = Time between the last AP and CD Preamble. τ_{p-cdp} has a minimum value of $\tau_{p-cdp, \min}$ which is either 3 or 4 access slots, depending on T_{epch}

τ_{cdp-a2} = Time between the CD Preamble and the CD/CA-ICH has two alternative values: 7680 chips or 12800 chips, depending on T_{epch}

$\tau_{cdp-pcp}$ = Time between CD Preamble and the start of the Power Control Preamble is either 3 or 4 access slots, depending on T_{epch} .

The time between the start of the reception of DL-DPCCH slot at UE and the Power Control Preamble is T_0 chips, where T_0 is as in subclause 7.6.3.

The message transmission shall start 0 or 8 slots after the start of the power control preamble depending on the length of the power control preamble.

Figure 32 illustrates the PCPCH/AICH timing relationship when T_{cpch} is set to 0 and all access slot subchannels are available for PCPCH.

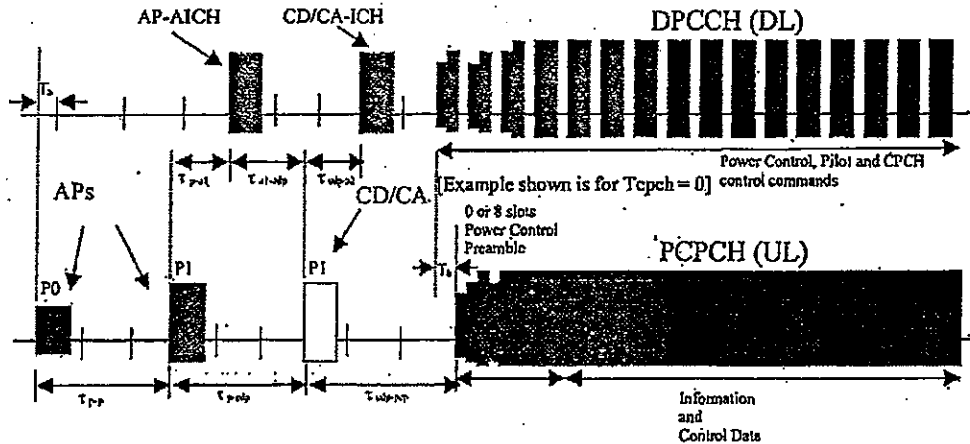


Figure 32: Timing of PCPCH and AICH transmission as seen by the UE, with $T_{cpch} = 0$

7.5 DPCH/PDSCH timing

The relative timing between a DPCH frame and the associated PDSCH frame is shown in figure 33.

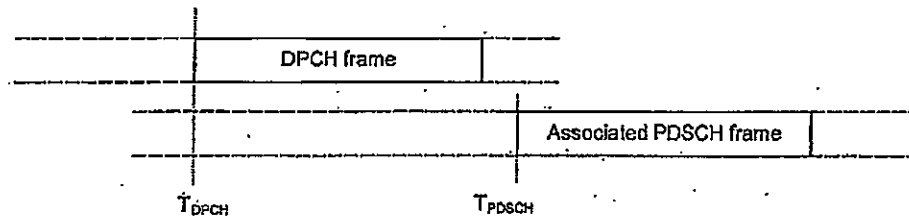


Figure 33: Timing relation between DPCH frame and associated PDSCH frame

The start of a DPCH frame is denoted T_{DPCH} and the start of the associated PDSCH frame is denoted T_{PDSCH} . Any DPCH frame is associated to one PDSCH frame through the relation $46080 \text{ chips} \leq T_{PDSCH} - T_{DPCH} < 84480 \text{ chips}$; i.e., the associated PDSCH frame starts between three slots after the end of the DPCH frame and 18 slots after the end of the DPCH frame, as described in subclause 7.1.

7.6 DPCCH/DPDCH timing relations

7.6.1 Uplink

In uplink the DPCCH and all the DPDCHs transmitted from one UE have the same frame timing.

7.6.2 Downlink

In downlink, the DPCCH and all the DPDCHs carrying CCTrCHs of dedicated type to one UE have the same frame timing.

Note: support of multiple CCTrCHs of dedicated type is not part of the current release.

7.6.3 Uplink/downlink timing at UE

At the UE, the uplink DPCCH/DPDCH frame transmission takes place approximately T_0 chips after the reception of the first detected path (in time) of the corresponding downlink DPCCH/DPDCH frame. T_0 is a constant defined to be 1024 chips. The first detected path (in time) is defined implicitly by the relevant tests in [14]. More information about the uplink/downlink timing relation and meaning of T_0 can be found in [5].

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Annex A (informative): Change history

Change history							
Date	TSG	SG Doc	Rev	Rev	Subject of Change	3GPP	ETSI
	RAN_05	RP-99587	-	-	Approved at TSG RAN #5 and placed under Change Control	-	3.0.0
14/01/00	RAN_06	RP-99676	001	1	Removal of superframe notation	3.0.0	3.1.0
14/01/00	RAN_06	RP-99677	002	-	Use of CPICH in case of open loop Tx	3.0.0	3.1.0
14/01/00	RAN_06	RP-99677	003	2	CPCH power control preamble length	3.0.0	3.1.0
14/01/00	RAN_06	RP-99684	005	1	Editorial corrections	3.0.0	3.1.0
14/01/00	RAN_06	RP-99676	006	-	Change to the description of STTD for SCH	3.0.0	3.1.0
14/01/00	RAN_06	RP-99678	007	1	Introduction of compressed mode by higher layer scheduling	3.0.0	3.1.0
14/01/00	RAN_06	RP-99676	008	1	Modifications to STTD text	3.0.0	3.1.0
14/01/00	RAN_06	RP-99684	009	1	20 ms RACH message length	3.0.0	3.1.0
14/01/00	RAN_06	RP-99676	010	-	Update to AICH description	3.0.0	3.1.0
14/01/00	RAN_06	RP-99678	011	1	Sliding paging indicators	3.0.0	3.1.0
14/01/00	RAN_06	RP-99677	016	-	TAB structure and timing relation for USTS	3.0.0	3.1.0
14/01/00	RAN_06	RP-99677	017	-	Timing for initialisation procedures	3.0.0	3.1.0
14/01/00	RAN_06	RP-99677	022	-	Modification of the STTD encoding scheme on DL DPCH with SF 512	3.0.0	3.1.0
14/01/00	-	-	-	-	Change history was added by the editor	3.1.0	3.1.1
31/03/00	RAN_07	RP-000060	013	6	Addition of a downlink channel indicating CPCH status	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	023	6	CPCH-related editorial changes, technical changes and additions to 25.211 and some clarifications to 7.4 PCPCH/AICH timing relation.	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	024	1	Additional description of TX diversity for PDSCH	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	025	1	Consistent numbering of scrambling code groups	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	026	-	Minor corrections to timing section	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	028	1	Timing of PDSCH	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	029	1	Modifications to STTD text	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	031	4	CD/CA-ICH for dual mode CPCH	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	033	-	Clarification of frame synchronization word and its usage	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	034	1	Editorial updates to 25.211	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	036	-	PDSCH multi-code transmission	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	037	-	Clarification of pilot bit patterns for CPCH and slot formats for CPCH PC-P and message part	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	039	-	Further restrictions on the application of the Tx diversity modes in DL	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	040	-	Clarification of downlink pilot bit patterns	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	041	-	Clarification of DCH initialisation	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	044	2	Emergency Stop of CPCH transmission and Start of Message Indicator	3.1.1	3.2.0
31/03/00	RAN_07	RP-000060	046	-	Clean up of USTS related specifications	3.1.1	3.2.0
26/06/00	RAN_08	RP-000265	047	4	Clarifications to power control preamble sections	3.2.0	3.3.0
26/06/00	RAN_08	RP-000265	048	-	Propagation delay for PCPCH	3.2.0	3.3.0
26/06/00	RAN_08	RP-000265	049	1	PICH undefined bits and AICH, AP-ICH, CD/CA-ICH non-transmitted chips	3.2.0	3.3.0
26/06/00	RAN_08	RP-000265	051	1	Bit value notation change for PICH and CSICH	3.2.0	3.3.0
26/06/00	RAN_08	RP-000265	053	1	Revision of notes in sections 5.3.2 and 5.3.2.1	3.2.0	3.3.0
26/06/00	RAN_08	RP-000265	054	5	Slot format clarification for CPCH	3.2.0	3.3.0
26/06/00	RAN_08	RP-000265	055	3	Physical channel nomenclature in FDD	3.2.0	3.3.0
26/06/00	RAN_08	RP-000265	056	3	Clarification for the PDSCH channelisation code association with DPCH in 25.211	3.2.0	3.3.0
26/06/00	RAN_08	RP-000265	057	2	Clarification for the PDSCH channelisation code association with DPCH in 25.211	3.2.0	3.3.0
26/06/00	RAN_08	RP-000265	058	-	Clarification of spreading factor for AICH	3.2.0	3.3.0
26/06/00	RAN_08	RP-000265	060	-	Explicit mention of slot format reconfiguration also for uplink	3.2.0	3.3.0
23/09/00	RAN_09	RP-000340	065	-	Correction of reference	3.3.0	3.4.0
23/09/00	RAN_09	RP-000340	066	4	Clarification of paging indicator mapping	3.3.0	3.4.0
23/09/00	RAN_09	RP-000340	068	-	Editorial modification of the 25.211 about the CD/CA-ICH	3.3.0	3.4.0
23/09/00	RAN_09	RP-000340	070	1	Support of closed loop transmit diversity modes	3.3.0	3.4.0
23/09/00	RAN_09	RP-000340	071	-	DPCH initialisation procedure	3.3.0	3.4.0
23/09/00	RAN_09	RP-000340	072	3	Correction on indicators	3.3.0	3.4.0
23/09/00	RAN_09	RP-000340	074	-	Correction of STTD for DPCH	3.3.0	3.4.0
23/09/00	RAN_09	RP-000340	075	-	Clarification of first significant path	3.3.0	3.4.0
23/09/00	RAN_09	RP-000340	076	-	Clarification of SCH transmitted by TSTD	3.3.0	3.4.0
23/09/00	RAN_09	RP-000340	077	1	Clarification of FBI field	3.3.0	3.4.0
15/12/00	RAN_10	RP-000537	079	2	Clarification of downlink phase reference	3.4.0	3.5.0

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Change history							
Date	Release	TS Doc	Ver	Rev	Subject/Comment	Old	New
15/12/00	RAN_10	RP-000537	083	1	DL Transmission in the case of invalid data frames	3.4.0	3.5.0
15/12/00	RAN_10	RP-000537	084	-	Clarification of figura 28	3.4.0	3.5.0
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